REPORT RESUMES

ED 012 842 AC 000 770

COMMENTS, AND LEGAL BRIEF AND COMMENTS, BEFORE THE FEDERAL COMMUNICATIONS COMMISSION, IN THE MATTER OF THE ESTABLISHMENT OF DOMESTIC NON-COMMON CARRIER COMMUNICATIONS-SATELLITE FACILITIES BY NON-GOVERNMENTAL ENTITIES, DOCKET 16495.
FORD FOUNDATION, NEW YORK, N.Y.

PUB DATE 1 AUG 66
EDRS PRICE MF-$0.50 HC-$4.52 113P.

DESCRIPTORS- *COMMUNICATION SATELLITES, *EDUCATIONAL TELEVISION, *LEGAL PROBLEMS, *MEDIA TECHNOLOGY, *PUBLIC POLICY, ESTIMATED COSTS, FEDERAL LEGISLATION, COMMERCIAL TELEVISION, FINANCIAL POLICY, STATISTICAL DATA, ADMINISTRATIVE ORGANIZATION, FEDERAL COMMUNICATIONS COMMISSION, UNITED STATES, FORD FOUNDATION,

VOLUME I OF THE FORD FOUNDATION SUBMISSION TO THE FEDERAL COMMUNICATIONS COMMISSION STATES THE FOUNDATION'S COMMITMENT TO EDUCATIONAL BROADCASTING, DESCRIBES THE SCOPE, SERVICES, COMPONENTS, AND COST OF A PROPOSED NATIONAL BROADCASTERS' NON-PROFIT SATELLITE SERVICE (BNS), ASSERTS THE SOCIAL, ECONOMIC, AND OPERATIONAL BENEFITS OF SUCH A SYSTEM, AND DISCUSSES THE FEASIBILITY OF ACCOMMODATING BNS TRANSMISSION UNDER EXISTING RESTRICTIONS ON POWER DENSITY OR EVEN OF MODERATING THESE RESTRICTIONS. VOLUME II CONTAINS A LEGAL BRIEF AND ARGUMENTS IN SUPPORT OF THE FOLLOWING CONTENTIONS--(1) THAT THE COMMUNICATIONS ACT OF 1934, THE COMMUNICATIONS SATELLITE ACT OF 1962, AND THE INTERNATIONAL COMMUNICATIONS SATELLITE AGREEMENTS MADE IN 1965 DO NOT PRECLUDE CREATION OF SUCH FACILITIES BY DOMESTIC NONCOMMON CARRIERS, AND (2) THAT THE NATIONAL AND PUBLIC INTEREST WOULD BE SERVED BY AUTHORIZING A NONPROFIT CORPORATION TO ESTABLISH AND OPERATE SUCH FACILITIES FOR NATIONAL COMMERCIAL AND NONCOMMERCIAL TELEVISION. DOCUMENT INCLUDES A GLOSSARY, 10 TECHNICAL CHARTS AND FIGURES, AND FIVE TABLES. (LY)

ED012842

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C. 20554

In the Matter of the

Establishment of domestic non-common carrier communications-satellite facilities by non-governmental entities.

DOCKET
NO. 16495

LEGAL BRIEF AND COMMENTS OF THE FORD FOUNDATION IN RESPONSE TO PARAGRAPHS 4(a) AND 4(b) OF THE COMMISSION'S NOTICE OF INQUIRY OF MARCH 2, 1966, IN THE ABOVE-ENTITLED MATTER

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August 1, 1966

AC000770

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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"4(a) Whether, as a matter of law, the Commission may promulgate policies and regulations, looking toward the authorization of non-governmental entities to construct and operate communication-satellite facilities for the purpose of meeting their private or specialized domestic communications requirements. This proceeding is not concerned with the question of whether communications common carriers may be authorized to construct and operate communication-satellite facilities for domestic purposes. . . .

"(b) The effect or impact of any such authorizations upon the policies and goals set forth by the Communications Satellite Act and upon the obligations of the United States Government as a signatory to the Executive Agreement Establishing Interim Arrangements for a Global Commercial Communications Satellite System."

Summary of Argument

I.

Analysis of the language of the 1934 Act, its legislative history, and judicial and Commission decisions interpreting it, make clear that the Act provides the Commission with the power at issue. Section 303(g) of the Act specifically directs the Commission to "generally encourage the larger and more effective use of radio in the public interest." Authorization of a national non-profit radio and television satellite distribution service that would promote non-commercial television would fall squarely within this mandate. Congress, the Commission, and the Executive have all expressed strong national interest in the development of non-commercial television.

In 1961, the Commission itself concluded that it had power to authorize private use of communication satellites. And the legislative history of the 1962 Act reveals general support for the Commission's view of its statutory power among those Congressmen and others who considered the matter.

Judicial and Commission decisions also confirm this conclusion. The 1934 Act has been uniformly interpreted to grant the Commission broad power. And the Commission has been consistently upheld in its extension of this power to means of electrical communication that were unforeseen in 1934. Television broadcasting is a prime example.

II.

The Communications Satellite Act of 1962 does not preclude exercise of the power granted to the Commission in the 1934 Act. The purpose of the 1962 Act was to establish a commercial communications satellite system, not the system, and the arrangement envisaged was international, not domestic.

Section 102(d) of the 1962 Act expressly recognizes the Commission's power: "It is not the intent of Congress by this Act . . . to preclude the creation of additional communications satellite systems if required to meet unique governmental needs or if otherwise required in the national interest." The system proposed by the Foundation would satisfy this standard. The legislative history of Section 102(d) shows that Congress considered and rejected the position that further legislation is a prerequisite to Commission authorization of additional domestic communications-satellite facilities.

III.

The 1964 International Agreements, like the 1962 Act, do not restrict the Commission's exercise of its power. They were aimed at creating a system to serve international needs, not the system to service the special domestic requirements of more than 50 signatory nations. Moreover, a separate system operated by Comsat to meet these requirements might raise serious conflict-of-interest problems.

IV.

In determining whether to authorize non-common carriers to construct and operate domestic communications-satellite facilities to serve their specialized needs, the Commission must consider whether such facilities would serve the "public convenience, interest, or necessity," under the 1934 Act and are "required in the national interest" under the 1962 Act.

A national non-profit radio and television satellite distribution service that would promote non-commercial television would meet both tests. Members of the Commission, Congress, and the Executive have emphasized the need for the rapid development of non-commercial television. Many have urged a nationwide educational television network. If such a system is to become an early reality, it will require the use of communications satellites. Communication satellites are the most efficient and economical means for long-distance communications. Recent studies have shown that educational television by satellite is both economically and technologically feasible.

Furthermore, neither the national interest nor the public interest requires that Comsat or the common carriers be protected against a national non-profit radio and television satellite distribution service. Such a service would have an insignificant effect on common carriers compared with the economic hardship the Commission sought to prevent in the Authorized User inquiry.

Argument

I.

THE COMMUNICATIONS ACT OF 1934 EMPOWERS THE COMMISSION TO AUTHORIZE PRIVATE NON-COMMON CARRIERS TO CONSTRUCT AND OPERATE COMMUNICATIONS-SATELLITE FACILITIES TO MEET THEIR SPECIALIZED DOMESTIC COMMUNICATIONS NEEDS.

A. The Language of the 1934 Act.

When the Communications Act of 1934 was adopted, communications satellites were beyond the realm of science fiction. Television had barely been conceived. Radio was the only means of mass telecommunication. Congress was fully aware, however, that the future directions and dimensions of telecommunications technology would range far beyond those of the 1930's.

To meet this challenge, Congress recognized that the new federal regulatory agency had to be provided with "regulatory power over all forms of electrical communications ...." S. Rep. No. 781, 73d Cong., 2d Sess., at 1 (1934).* And it knew that the Commission needed authority not only to supervise industry but also to encourage development of new means of telecommunications. See, e.g., Hearings on H.R. 8301 Before the House Committee on Interstate and Foreign Commerce, 73d Cong., 2d Sess., at 21 (1934).

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* Unless otherwise stated, emphasis is added.

To meet these requirements, the 1934 Act provided that the Commission should seek "to make available, so far as possible, to all people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities . . . ." (47 U.S.C. § 151 (1964).)* "Radio Communication" is defined to include not only "the transmission by radio of writing, signs, signals, pictures, and sounds of all kinds," but also "all instrumentalities, facilities, apparatus, and services . . . incidental to such transmission." (Section 153(b).) Communication by satellite is, of course, a form of radio communication that uses satellites as its "instrumentalities." The microwave repeater systems by which communications are sent via satellite differ from terrestrial microwave systems only in that the repeaters are placed in satellites thousands of miles above the earth.

The powers of the Commission are specified in subchapter 3 of the Act, in which the Congress sought "to maintain the control of the United States over all channels of interstate and foreign radio transmission; and to provide for the use of such channels . . . ." (Section 301.) Specifically, Congress authorized the Commission in section 303, "as public convenience, interest, or necessity requires," to "generally encourage the larger and more effective use of radio in the public interest." (Subsection (g).) And the Commission was directed to "make such rules and regulations . . . as may be necessary to carry out the provisions of this chapter . . . ." (Subsection (r).) Finally, in inquiries such as this one, the Act does not differentiate between common carriers and non-common carriers, except in terms of "public convenience, interest, or necessity" (discussed below in Part IV). See Allocation of Microwave Frequencies Above 890 Mc., 27 F.C.C. 359 (1959), 29 F.C.C. 825 (1960) (reconsideration).

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* All subsequent citations to the 1934 Act are to 47 U.S.C. (1964).

A Commission grant of authority to a non-profit corporation to construct and operate communication-satellite facilities for transmission of commercial and non-commercial radio and television broadcasting would fall squarely within the mandate of section 303(g). The policy behind this provision was stated during the Congressional hearings on the Act. "Our supremacy in radio cannot be maintained except by active encouragement and development of its use. Its possibilities are almost untouched today. . . . Who knows what future developments may bring?" Hearings on H.R. 8301 Before the House Committee on Interstate and Foreign Commerce, 73d Cong., 2d Sess., at 21 (1934). This policy can be carried out only if the Commission continues to respond to new demands for services resulting from technological advances such as communications satellites.

Authorization for a satellite service intended to promote national, non-commercial television broadcasting would particularly serve the policies of the 1934 Act. Additions to the Act in 1962 express the strong Congressional interest in encouraging the development of educational television. Sections 390-97 provide for federal grants of assistance for "provision of educational television broadcasting facilities which will serve the greatest number of persons and serve them in as many areas as possible, and which are adaptable to the broadest educational uses." (Section 392(d)(3).) And section 395 directs the Commission to assist the Secretary of Health, Education, and Welfare in promoting educational television.*

B. In 1961 the Commission Concluded It Had Power to Authorize Private Use of Communications Satellites.

In February 1961, the Commission concluded a memorandum of understanding with NASA on "Respective Civil Space Communications Activities." See Hearings on Communications Satellites Before the House Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., pt. 1, at 6 (1961). This memorandum stated that each agency had adequate statutory authority "to proceed expeditiously with the research and development activities necessary to achieve a commercially operable communication satellite system."

One month later, the Commission issued a notice of inquiry into the general topic of commercial use of communications satellites. One of the issues specifically raised by the Commission was whether it had statutory power to proceed in this area. Inquiry Into the Administrative and Regulatory Problems Relating to the Authorization of Commercially Operable Space Communications System, para. 5(3), FCC Docket No. 14024. (March 29, 1961.)

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* Section 395 provides:

> The Federal Communications Commission is authorized to provide such assistance in carrying out the provisions of sections 390-397 of this title as may be requested by the Secretary [of Health, Education, and Welfare]. The Secretary shall provide for consultation and close cooperation with the Federal Communications Commission in the administration of

All the statements and briefs in response to the notice of inquiry concluded that the Commission did have such power. Chairman Minow summed up these responses:

> In our first inquiry we asked this question of everyone else, everyone who participated in it, Government agencies and industry, and the Department of Justice, as to their views on our statutory authority.
>
> And no one at that time suggested that any legislation was needed.

Hearings on Communications Satellites Before the House Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., pt. 1, at 86 (1961).

Accordingly, in its First Report following the notice of inquiry the Commission did not even discuss the question of its authority but moved at once to the major problems of ownership of and participation in a communications-satellite system. And in its Memorandum Opinion and Order following the inquiry, the Commission simply assumed its power to proceed. It then created the *Ad Hoc* Carrier Committee to explore possible programs of space satellite communications, owned by private enterprise, that the Commission might license in the future. See Supplemental Notice of Inquiry, FCC Docket No. 14024.

Before the Commission was able to consider concrete plans for a communications-satellite system, Congress began its investigation into the problem. This investigation ultimately led to the Communications Satellite Act of 1962. The legislative history of that Act, however, reveals general agreement among

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his functions under sections 390-397 of this title which are of interest to or affect the functions of the Commission.

those Congressmen and others who considered the point that the Commission had the power under the 1934 Act to authorize communications satellites for commercial use. Chairman Minow spoke on behalf of the Commission at nearly a dozen hearings and consistently maintained that the Commission had such power. Following are typical excerpts from his testimony:

> [I]n all communications, and in all uses of the radiofrequency, this has been the FCC's statutory responsibility, and we regard what we are doing [making plans for future satellite utilization] as pursuant to the [1934] statute. If not, we will be very happy if Congress would indicate otherwise.
>
> . . . .
>
> [W]e have the authority to license anything but it has to be a private user. . . . The law would permit us to license a private user for space satellite communications.
>
> . . . .
>
> But assuming the decision is to encourage a private international satellite system, we felt that the law presently is adequate.

Hearings on Space Satellite Communications Before the Subcommittee on Monopoly of the Senate Select Committee on Small Business, 87th Cong., 1st Sess., at 652, 662, 471 (1961).

Former Commissioner Craven also asserted the Commission's "exclusive jurisdiction to authorize all non-government wire and radio operations in interstate and foreign commerce" and said that with the cooperation of NASA this exclusive jurisdiction extended to communications-satellite facilities. *Hearings on Communications Satellites Before the House Committee on Science and Astronautics*, 87th Cong., 1st Sess., pt. 1, at 498-99 (1961).

Testimony at the hearings by various officials in the Executive Branch made it clear that they viewed the Commission's power as extending to the authorization of private owners and operators of communications-satellite facilities. The following exchange between then Assistant Attorney General Loevinger and Representative Rogers is illustrative of this testimony:

> Mr. Rogers: If the FCC decided that it was advisable and in the national interest to move ahead quickly with the program before details were worked out, they could do so. I presume they would not do so without consultation, but as a matter of law they could.
>
> Mr. Loevinger: Yes; I believe so.

Hearings on Communications Satellites Before the House Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., pt. 1, at 153 (1961). See also testimony by then Assistant Attorney General Katzenbach in support of the Commission's authority, infra p. 21.

Finally, many Congressmen expressed their view that the Commission had the power that is here the subject of inquiry. Rep. Oren Harris, chairman of the House Committee on Interstate and Foreign Commerce, for example, stated:

> This is a continuation of our hearings on the development of this new system of communications in relation to ownership, its development, and to its operation, particularly commercial operation, which comes under the jurisdiction of the Federal Communications Commission.

Hearings on Communications Satellites Before the House Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., pt. 1, at 170 (1961).

C. Prior Judicial and Commission Decisions Support the Commission's Power.

1. The 1934 Act Has Been Uniformly Interpreted to Grant the Commission Broad Power.

The Commission has consistently maintained that the 1934 Act gave it ample authority to meet changing circumstances and the demands of a rapidly developing technology, see, e.g., Amendment of Rules to Provide for Subscription Television Service, 23 F.C.C. 532, 536 (1957), and the courts have regularly supported this view. In NBC v. United States, for example, Justice Frankfurter stated that "Congress endowed the Communications Commission with comprehensive powers to promote and realize the vast potential of radio." 319 U.S. 190, 217 (1943). "Congress," he said, "was acting in a field of regulation which was both new and dynamic. . . . In the context of the developing problems to which it was directed, the Act gave the Commission not niggardly but expansive powers." 319 U.S. at 219.

More recently the Supreme Court has said: "/T/he Commission was to be guided by the 'public interest, convenience, or necessity' . . . . The statutory standard no doubt leaves wide discretion and calls for imaginative interpretation." FCC v. RCA Communications, Inc., 346 U.S. 86, 90 (1953). See also United States v. Storer Broadcasting Co., 351 U.S. 192, 203 (1956): The Commission's "authority covers new and rapidly developing fields."

The federal courts of appeals have responded to this call for a broad interpretation of the Commission's powers. In ABC v. FCC, 191 F.2d 492, 498 (D.C. Cir. 1951), the court stated:

> In performing its functions under the Act the Commission is given a broad discretion. The statute contemplates that the Commission will 'take the lead in exploring the possibilities of radio, and we think it unlikely that Congress had in mind a particular method to this end.' . . . The purpose of Congress in establishing the Commission was to set up an expert agency capable of coping with the ever-changing and constantly-increasing problems of a booming industry.

And in Connecticut Committee against Pay TV v. FCC, 301 F.2d 835, 837 (D.C. Cir.), cert. denied, 371 U.S. 816 (1962), the same court concluded that section 303(g) "makes clear that Congress placed an affirmative duty on the Commission to experiment with and develop the most desirable deployment and utilization of the nation's communications facilities."

2. The Commission's Power Has Been Consistently Held to Extend to Means of Electrical Communication that Were Unforeseen in 1934.

Underlying the 1934 Act, the Supreme Court has said, "is recognition of the rapidly fluctuating factors characteristic of the evolution of broadcasting and of the corresponding requirement that the administrative process possess sufficient flexibility to adjust itself to these factors." FCC v. Pottsville Broadcasting Co., 309 U.S. 134, 138 (1940).

The lower courts have uniformly followed this approach in applying the Act to new technological developments. They have, for example, affirmed the Commission's assertion of plenary power over television broadcasting, although Congress was unaware of the impending utilization of this recent discovery in 1934.

The court in Peoples Broadcasting Co. v. United States, 209 F.2d 286, 287 (D.C. Cir. 1953), reviewing the Commission's role in bringing television to the American people, stated:

> The Commission had authority to adopt a nationwide television allocation plan. The purposes of the creation of the Commission, as expressed by Congress /citing section 151/, and the mandates pursuant to the purposes, enumerated at great length in the statute /citing section 303/, furnish ample support for this action.

The same result had been reached in Allen B. Dumont Laboratories v. Carroll, 184 F.2d 153 (3d Cir. 1950), cert. denied, 340 U.S. 929 (1951), in which television was construed to be part of radio communication as defined in section 153. The court concluded that "the Communications Act of 1934 applies to every phase of television . . . ." 184 F.2d at 155.

In 1927 and 1934 the reception by the public of radio broadcasts had always been without charge, yet in 1957 when a proposal for subscription television was placed before the Commission, it authorized a three-year trial of this new use of the medium. The language of the Commission's opinion is pertinent to the present inquiry:

> As in the case of numerous other types of services which have been authorized by the Commission, the statute makes no specific mention of subscription television which can be construed as a direct authorization or prohibition of such a service. It was not possible when the legislation was enacted, any more than it is now, to foresee all possible developments in the use of the radio spectrum. From the beginning, all phases of radio have undergone continual development and change, spurred by the inventiveness of a dynamic industry. Manifestly this fact was fully recognized by Congress and explains the latitude of licensing powers the Commission was authorized and directed to exercise in conformity with the basic standards and specific requirements laid down in the act.

Amendment of Rules to Provide for Subscription Television Service, 23 F.C.C. 532, 536 (1957).

The Commission has also concluded that it has the power to authorize educational-television broadcasts via aircraft, and that such authorizations are in the public interest when consistent with efficient use of the frequency spectrum. See Airborne Television Transmitters, FCC Docket No. 15201, 5 Pike & Fischer R.R. 2d 1727 (1965), 6 id. at 1613 (1965) (reconsideration), in which Commission "reluctantly" held that authorization of six regular channels to Midwest Program for Airborne Television Instruction, Inc. would not be an efficient use of the frequency spectrum, but continued authorization of two experimental channels.

The similarity between this "instrumentality" of radio communication and satellites is striking.

Finally, the courts and the Commission have made clear that involvement of space and spacecraft do not oust the Commission of jurisdiction. See California Interstate Telephone Co. v. FCC, 328 F.2d 556 (D.C. Cir. 1964): Transmission into space is "foreign transmission" under section 153(f); Proposed Amendment of Rules to Provide for the Allocation of Frequencies for Space Communication in the International Fixed Public Radio Service, FCC 61-77, 21 Pike & Fischer R.R. 1514 (1961); AT&T allocated bands in which to experiment with space-satellite communications.

II.

THE COMMUNICATIONS SATELLITE ACT OF 1962 DOES NOT PRECLUDE COMMISSION AUTHORIZATION OF PRIVATE NON-COMMON CARRIERS TO CONSTRUCT AND OPERATE COMMUNICATIONS-SATELLITE FACILITIES TO MEET THEIR SPECIALIZED DOMESTIC COMMUNICATIONS NEEDS.

A. The Primary Purpose of the 1962 Act was to Establish an International Communications Satellite System.

The 1962 Act was intended as a major step toward a "global communications network." (Section 102(a).) The motivating force behind enactment was exclusively international -- to establish American preeminence in space communications. See, e.g., Letter from President Kennedy to the President of the Senate and the Speaker of the House of Representatives, transmitting S. 2814, in S. Rep.

No. 1584, 87th Cong., 2d Sess. 29 (1962): The legislation would "provide a dramatic demonstration of our leadership in this area of space activity . . . ."

Throughout the entire Congressional consideration of the measure, it was viewed as a means "to bring into being a private corporation which would be the U.S. participant in a *global satellite communications system*." H.R. Rep. No. 1636, 87th Cong., 2d Sess. 7 (1962). Comsat's own prospectus stated that it was created under the 1962 Act to "establish and operate a *global commercial communications satellite system* in cooperation with telecommunications entities in other countries. . . ." (*Prospectus*, p. 3.) This system would "use satellites placed in orbit around the earth to relay telecommunications *between* terminal stations in the United States *and in other countries* . . . ." *Ibid*. See also 108 Cong. Rec. 10649 (remarks of Senator Pastore) (1962); H.R. Rep. No. 178, 89th Cong., 1st Sess. 89 (1965): "*[T]he system is to be global in extent and universal in service*."

This was the reason, for example, why the legislation was referred to the Senate Foreign Relations Committee, see S. Rep. No. 1873, 87th Cong., 2d Sess. (1962), why State Department witnesses testified at virtually every Congressional hearing on the statute, and why the Act granted the President such extraordinarily broad powers over the affairs of a private corporation. (Section 201(a).)

Two considerations caused Congress to focus almost exclusively on international communications. First, an international system was seen both as a means to move ahead of the Soviet Union, which had apparently taken the lead in space technology, and as a way to enable the United States to assert a position of leadership at the Extraordinary Administrative Radio Conference of the International Telecommunications Union called in 1963 to allocate frequencies for communications satellite systems.* See H.R. Rep. No. 178, 89th Cong., 1st Sess. 22 (1965).

Second, in 1962 random satellites patterned on Telstar were seen as the model for many years to come. Such satellites, since they orbited the globe, made sense only in the context of an international system. Moreover, the high costs of a satellite system as projected in 1962 made it economically attractive only as an alternative to costly submarine cables. See, e.g., testimony of

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* The following remarks typified Congressional views:

House Report: "If a national policy of private ownership and operation of the U.S. portion of the international system is to be assured, the instrumentality therefor must be established now." H.R. Rep. No. 1636, 87th Cong., 2d. Sess. 8 (1962).

Senator Cotton: [Having an operational system in time for the 1963 Conference is] "virtually a life-and-death matter. . . ." 108 Cong. Rec. 16569 (1962).

Senator Javits: "But the fact is that in the presence of the two space ships that the Russians have in the atmosphere today, the only counter-propaganda we have is Telstar." Id. at 16574.

Senator Lausche: "The Soviets are orbiting. We are filibustering." Id. at 16416.

Senator Pastore: "If we are to pin Russia to the mat at all, we should not delay this any longer. . . ." Id. at 15124.

Senator Magnuson: "The U.S. Government cannot be in a strong position at the 1963 meeting if the United States does not have an operable system." Id. at 15026.

Senator Smathers: "There is an important time element with respect to

Chairman Minow in Hearings on Communications Satellites Before the House Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., pt. 1, at 5 (1961). For the "foreseeable future," therefore, domestic satellite service seemed technologically and economically infeasible.

At the same time, however, Congress realized that flexibility was an absolute necessity and that the "foreseeable future" had to be measured in months, not decades. As Representative Springer, ranking minority member of the House Interstate and Foreign Commerce Committee, stated:

> Experience with satellite communications at this point is almost nonexistent. We are entering a field that is almost as revolutionary in 1962 as was Columbus' voyage in 1492. Experience alone can dictate to us in the future what course of action should be taken.

108 Cong. Rec. 7503 (1962).

Only in this context can it be understood why section 102(d) is the sole provision in the Act concerning domestic service and why there are just a few scattered references to domestic service in the many thousands of pages of the statute's legislative history.*

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the bill, because if it is delayed to such an extent that the Soviet Union puts the first communications satellite into space, the United States will have lost forever the position and prestige. So there is an emergency." Id. at 11285.

* During the course of debate on the Act, Senator Long did express concern that:

> This whole thing has never been even explored, considered, or advocated as a way of providing cheaper telephone service between New York and Chicago, or Chicago and Los Angeles, or Chicago and New Orleans. It has only been discussed on the basis that it would provide a service overseas, inter-

Congress considered the Act as a means to promote "a commercial communications satellite system," (section 305(a)(1),)not the system, and the arrangement envisaged was international not domestic. The legislation should not, therefore, be read as precluding other private systems serving only specialized domestic needs.

B. Section 102(d) of the 1962 Act Expressly Recognizes the Power of the Commission to Authorize Private Domestic Communications-Satellite Systems.

1. The Language of Section 102(d).

Section 102(d) provides:

> It is not the intent of Congress by this Act to preclude the use of the communications satellite system for domestic communication services where consistent with the provisions of this Act nor to preclude the creation of additional communications satellite systems, if required to meet unique governmental needs or if otherwise required in the national interest.

In this section, Congress expressed its intent on two issues. First, the international system envisaged in the statute might be used for domestic purposes if this could be done in a manner consistent with the other obligations imposed on Comsat by the Act. Second, other systems might be established "to meet unique governmental needs or if otherwise required in the national interest."

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nationally.

> The big savings and the tremendous profits which could be made, and the great service to the American people, would be the domestic service. That is to be precluded from all consideration.

108 Cong. Rec. 16213 (1962).

2. The Legislative History of Section 102(d).

The fact that Congress did not intend by the 1962 Act to preclude Commission authorization of additional communications-satellite systems is clear from the legislative history of section 102(d). When the legislation was first passed by the House, section 102(d) had been amended to provide:

> The Congress reserves to itself the right to provide for additional communications satellite systems if required to meet unique governmental needs or if otherwise required in the national interest.

See H.R. 11040, as passed by the House of Representatives on May 3, 1962, and introduced in the Senate on May 4, 1962. The Senate refused to accept this language, however, and substituted the current version of section 102(d). The House then acceded to the Senate's version.

If Congress had adopted the House version, it would have been clear that the Act pre-empted the communications-satellite field and that further legislation would be required before additional domestic facilities could be developed. The defeat of the House version of section 102(d), however, shows that Congress squarely considered and rejected the position that further legislation is a prerequisite to Commission authorization of such facilities.

3. "It is not the intent of Congress . . . to preclude the creation of additional communications satellite systems, if required to meet unique governmental needs or if otherwise required in the national interest."

One of the purposes of the second "not precluded" clause in section 102(d) was to assure that the Government could develop its own satellite system to meet its "unique" communications needs. Substantial discussion in Congress was devoted to the nature of these needs. Congress was obviously concerned, for example, that an international consortium might own and operate the facilities by which vital classified messages would be sent. See, e.g., 108 Cong. Rec. 15060 (remarks of Senator Gore) (1962); Hearings on National Communications Satellite Programs Before the Senate Committee on Aeronautical and Space Sciences, 89th Cong., 2d Sess., at 6-7 (testimony of General Starbird) (1966).

A second purpose of that clause was to assure that non-governmental communications needs "required to be met in the national interest" could be fulfilled by additional systems. As Mr. Dingman, Executive Vice-President of A.T.&T. said, "sometime in the future it may be necessary to augment the initial system and this could involve the establishment of a new satellite system." Hearings on Communications Satellite Legislation Before the Senate Committee on Commerce, 87th Cong., 2d Sess. 202 (1962). A domestic satellite system, designed to serve purely national, as opposed to international, needs is the most obvious type of non-governmental system that could qualify under section 102(d).

Only a few witnesses before Congressional committees even mentioned the possibility of domestic satellite service in their testimony on the 1962 Act. For the most part, such service was simply not considered feasible. Then Assistant Attorney General Katzenbach did discuss the issue, however, in an exchange with Senator Kefauver, and his remarks support the view that the Act does not foreclose Commission authorization of private non-common carriers to construct and operate domestic communications-satellite facilities to serve their specialized needs.

Senator Kefauver: [speaking of Comsat] Why couldn't some of these chan-

> nels be held open for the television companies, . . . for all of these other hundreds of uses that would not come under FCC jurisdiction?
>
> Mr. Katzenbach: They would all come under FCC jurisdiction, sir, because as soon as you are using these facilities, as soon as you are using the radio spectrum, you are under FCC jurisdiction.
>
> Senator Kefauver: But you are forcing them to make a deal with one of the communications carriers, and what if they don't want to make a deal with a communications carrier?
>
> Mr. Katzenbach: *Then they have to get into the business themselves, sir. And I suppose if that is a practical way of doing it, then that is what should be done. But these are responsibilities as to who is to be licensed for what purposes, which are given to the Federal Communications Commission.*

Hearings on Antitrust Problems of the Space Satellite Communications System Before the Subcommittee on Antitrust and Monopoly of the Senate Committee on the Judiciary, 87th Cong., 2d Sess., pt. 1, at 55-56 (1962).

Finally, and particularly significant, Senator Church was the only Member of Congress to speak at length on section 102(d). His statement makes plain that the provision was intended to eliminate any possible implication that the Act precludes private non-common carrier development of communications-satellite facilities for specialized domestic purposes.

> The wisdom of the last clause /of section 102(d)/ 'or if otherwise required in the national interest' is perfectly apparent. *We cannot now foretell how well the corporate instrumentality established by this act will serve the needs of our people. If it should develop that the rates charged are too high, or the service is failing to extend to the American people the maximum benefits of the new technology*, or if the Government's use of the system for Voice of America broadcasts to certain other parts of the world proves to be excessively expensive for our taxpayers, *then certainly this enabling legislation should not preclude the establishment of alternative systems, whether under private or public management*. And just as certainly is that gateway meant to be kept open, just in case we would ever have to use it, by the language to be found in the bill's declaration of policy and purpose to which I have referred.

108 Cong. Rec. 16362 (1962).

4. "It is not the intent of Congress by this Act to preclude the use of the communications satellite system for domestic communication services where consistent with the provisions of this Act . . . ."

The first "not precluded" clause of section 102(d) underscores the essentially international character of the system envisaged in the Act. The very fact that Congress felt compelled to state that the Act did not preclude Comsat from providing domestic service compels the conclusion that international service is its main purpose.

Congress did not, however, provide the Commission with unrestricted power to authorize domestic satellite service by Comsat. Only if such service is "consistent with the provisions of the Act" may it be approved.

Comsat could provide domestic service either by means of a wholly separate domestic system or through the international system contemplated in the Act. Either course, however, might conflict with the Corporation's obligations under the Act.

Establishment of a separate domestic system must be measured against Comsat's mandate to "plan, initiate, construct, own, manage and operate itself or in conjunction with foreign governments or business entities a commercial satellite system." (Section 305(a)(1).) If Comsat had created the international system by "itself," leasing its facilities to foreign carriers, it would have no statutory obligations that might run contrary to establishment of a domestic system. Having acted "in conjunction with foreign governments," however, the Corporation may have a responsibility under the Act to devote its exclusive attention to promoting that system. Development of separate domestic satellite facilities might cause Comsat to divert its attention from the objectives of the international system. A conflict of interest might arise in which Comsat would favor the domestic system to the detriment of the international one. Such a situation would be clearly contrary to one of the stated aims of the Act -- international cooperation and understanding.

Establishment of domestic service as part of the international system might raise equally serious problems under the Act. Congress was, of course, aware that if foreign governments participated in the international system, it was unlikely that the United States would have absolute control. Congress must have foreseen that the international satellite facilities might be jointly owned and that Comsat might have only one voice among many. In fact, under the 1964 International Agreements, Comsat's foreign partners have a veto power over all significant actions of the international consortium. Comsat may make no major decisions without the support of at least two other signatories. See Article V of the Inter-Governmental Agreement, T.I.A.S. No. 5646 (1964).

Congress could not have intended that our domestic communications facilities were to be controlled, even in part, by foreign entities through their interests in the international system. Section 310(a) of the 1934 Act prohibits the granting of a station license to any alien or foreign government, or to any corporation organized under the laws of any foreign government. Furthermore, section 310(a) provides that no corporation may hold a station license if any officer or director is an alien or if more than 20% of the stock is owned or voted by aliens or foreign governments or corporations. And section 304(d) of the 1962 Act prohibits ownership of more than 20% of the public's share of Comsat's stock by foreign interests of the classes described in section 310(a) of the 1934 Act. In light of the attitude manifested in these and other similar statutory provisions, Congress could not have intended to vest control of domestic communications-satellite facilities in an international system partially controlled by foreign interests.

III.

THE 1964 INTERNATIONAL COMMUNICATIONS-SATELLITE AGREEMENTS DO NOT PRECLUDE ESTABLISHMENT OF DOMESTIC COMMUNICATIONS-SATELLITE FACILITIES BY NON-COMMON CARRIERS TO SERVE THEIR SPECIALIZED COMMUNICATIONS NEEDS.

The Inter-Governmental Agreement and the Special Agreement concluded in August 1964 were designed to establish "*a global commercial communications satellite system*." T.I.A.S. No. 5646 (1964). Nothing in the language of either instrument could be interpreted as precluding separate domestic systems. Like the 1962 Act, they were aimed at creating *a* system to serve *international* needs, not *the* system to serve the *domestic* requirements of more than 50 signatory nations.

Although the United States is not precluded by the 1964 Agreements from authorizing creation of separate domestic satellite systems, it may be that Comsat's operation of such a system would conflict with its obligations under the agreements.

Comsat is designated in Article VIII of the Inter-Governmental Agreement as "manager in the design, development, construction, establishment, operation and maintenance of the space segment." In this capacity, the Corporation has an obligation to devote itself to serving the best interests of the international system and all its participants. It seems probable that the other co-owners expected that Comsat would concentrate all its efforts on achieving the aims expressed in the Agreements -- "a single global communications satellite system . . . for the benefit of all nations of the world . . . at the earliest practicable date . . . ." Inter-Governmental Agreement, Preamble, T.I.A.S. No. 5646 (1964).

A serious conflict of interest could develop were Comsat to undertake a separate domestic system. At the very least, the energies and resources of the Corporation might be diverted from fulfilling its international role. More serious, the Corporation might find itself faced with a situation in which it could channel portions of the business either to the international system, thus earning no more than 61% of the profit, or to its own domestic system, thus earning 100%.

One of the basic purposes of the 1962 Act was to enhance the prestige of the United States as leader of an international undertaking designed to "contribute to world peace and understanding." (Section 102(a).) Even a possible conflict of interest on the part of Comsat could seriously jeopardize this aim.

IV.

THE NATIONAL AND THE PUBLIC INTEREST WOULD BE SERVED BY AUTHORIZING A NON-PROFIT CORPORATION

TO ESTABLISH AND OPERATE COMMUNICATIONS-SATELLITE FACILITIES FOR NATIONAL NON-COMMERCIAL AND COMMERCIAL TELEVISION.

A. The Proposed Non-Profit Corporation Will Meet the "Public Interest" Test Under the 1934 Act and the "National Interest" Test Under the 1962 Act.

Section 102(d) of the 1962 Act requires applicants for private communications-satellite systems to demonstrate that their proposed service is "required in the national interest." The 1934 Act demands a showing of "public convenience, interest, or necessity." (E.g., sections 303, 307.) These are the only limitations on the Commission's power to authorize either common carriers or non-common carriers to construct and operate domestic communications-satellite facilities. Cf. Amendment of Rules to Provide for Subscription Television, 23 F.C.C. 532 (1957).

There are, of course, no developed criteria under the 1962 Act for determining what is "required in the national interest."* The task of giving concrete meaning to the "national interest" requirement will fall to the Commission; it may be a difficult task to discharge in borderline cases. No matter how the term is defined, however, a national non-commercial television network will meet the standard. Financing such a network is a basic purpose of the Foundation's proposal.

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* Senator Church's statement on the purpose of section 102(d) reveals, however, that the term "national interest" permits not only private systems but also Government systems that do not qualify under the "unique governmental needs" clause. See supra p. 21. All governmental requirements do not affect the public directly, thus the term "national" rather than "public" was used.

Members of the Commission, Congress, and the Executive have all emphasized the need for rapid development of educational television to combat the education crisis in the United States. In Commissioner Hyde's words:

> /T/elevision represents a breakthrough in means of communicating light and knowledge comparable in significance to the development of the printing press and as indispensable to improvement of educational techniques as the latter.

Hearings on Educational Television Before the Communications Subcommittee of the Senate Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., at 121 (1961). President Kennedy said:

> Television, a device which has the potential to teach more things to more people in less time than anything yet devised, seems a providential instrument to come to education's aid. . . . Since education is a matter of national concern, the Federal Government should assist in expediting and accelerating the use of television as a tested aid to education in the schools and colleges of the Nation . . . .

Id., at 4-5.

> The Commission is aware of the substantial benefits which noncommercial education services bring to large populations and believes it desirable to encourage means by which the opportunities for the provision of such services may be enhanced.

Educational Reservation in Albany, N. Y., FCC Docket No. 14002, 23 Pike & Fischer R.R. 1563, 1564 (1962). See also Fifth Report, UHF Channel Assignments, FCC Docket No. 14229, 6 Pike & Fischer R.R. 2d 1643, 1660 (1966): "/W/e are vitally interested in the ultimate development of educational television into a true broadcasting service."

Television has proved to be a unique means of bringing instructional and other public-service programs into areas all over the globe. See, e.g., UNESCO, Rural Television in Japan, A Report on an Experiment in Adult Education (1960); Udall, We Start with Education to Make a More Livable America, NAEB Journal, Jan.-Feb., 1966, p. 59. See generally, Teaching by Television (A Report from the Ford Foundation and the Fund for the Advancement of Education) (2d ed. 1961); Schramm (ed.), The Impact of Educational Television (1960). The potential is enormous for bringing into schools and homes throughout the country concerts and plays, events of major political and international significance, all types of instruction -- an endless variety of programs of public importance.

The issue is not just the number of non-commercial stations or the number of hours a week of programming. If non-commercial television is to realize its potential, there must be a national network television with live national programming. Former Commissioner Ford stated: "I have urged the educational interests, the community in the United States, to design a nationwide educational television system and demand the channels to put it into effect." Hearings on Educational Television Before the Communications Subcommittee of the Senate Committee on Interstate and Foreign Commerce, 87th Cong., 1st Sess., at 118 (1961). Others have emphasized that

> The value of such a network arrangement is incalculable. Cities along the network would have access to each other's educational and cultural facilities. By lightening the burden of program production, the sharing of significant programs would enable each station to concentrate more intensively on improving the quality of its local school and adult programing. Moreover, the availability of network programing would provide an impetus for the construction of educational television stations that might not otherwise be established.

Id. at 138 (statement by Dr. J. Bernard Everett, Asst. Superintendent of Schools, Newton, Mass.). The network could also tie into Instructional Television Fixed Services, which the Commission so strongly advocates for the classrooms themselves.

If the proposed nationwide educational network is to become a reality, it will require the use of a communications satellite. Experience has revealed that communications satellites are today the most efficient and economical means for long-distance communications. Intercontinental educational television via satellite has already been successfully tried on an experimental basis. See Dreyfus & Gumpert, Students Visit Via Satellite, NAEB Journal, May-June, 1966, p. 6.

The most authoritative up-to-date analysis is in a detailed report recently prepared by a team of experts from Stanford University for UNESCO, on the feasibility of educational television by satellite. Schramm et al., A Pilot Test of an Educational Television Satellite (draft, May, 1966). The study was primarily concerned with establishing an educational television satellite for developing countries such as Brazil, India, or Mexico, but its conclusions are also of significance for this country. In summary, the authors believe

> that it is within the present state of the art to manufacture and orbit in the next two years a satellite capable of distributing television pictures of acceptable quality to school and community receivers equipped with 10-foot roof-top reflector antennas and converter preamplifier units that could be mass produced at an acceptable cost. Furthermore, we believe that a more powerful satellite representing the full potential of the spin stabilized synchronous design could be developed and orbited within three or four years at a considerable but not unreasonable development cost. This satellite could provide as many as four video channels to school and community centers, or as many as nine channels to urban rebroadcast centers. Various combinations of direct and rebroadcast channels could also be transmitted from this satellite.

Id. at i-ii. See also Miller, Hughes Proposes TV Broadcast Satellite, Aviation Week, Feb. 1, 1965, at 75; Putting Space to Work to Educate the World, Business Week, Dec. 25, 1965, at 17 (discussing a system originated by Hughes Aircraft for broadcast from a giant synchronous satellite to several hundred ground receivers, each costing no more than $1,200).

Lack of funds remains the primary obstacle to the prompt establishment of a national educational network. The Foundation's response to paragraph 4(c)(2) and 4(c)(4) of the Commission's Notice of Inquiry analyzes the economic problems of the existing situation, the difficulties of remedying them by traditional means, and the possibilities inherent in a non-profit corporation transmitting non-commercial and commercial television broadcasts via satellite facilities. Authorization of these facilities would accord with the Commission's traditional concern for the development of new and different non-profit enterprises to meet new and different needs. For example, in Amendment of the Commission's Rules to Permit Expanded Cooperative Sharing of Operational Fixed Stations, FCC Docket No. 16218 (July 15, 1966), the Commission emphasized

> we have long made the distinction between persons engaged in providing service as common carriers and those rendering service on a non-profit, cooperative basis.
>
> . . . .
>
> we have ample authority to prescribe any special method of regulating the cooperative use of private systems that would best serve the public interest. See Philadelphia Television Broadcasting Co. v. FCC, ___ U.S. App. D.C. ___, 359 F.2d 282 (1966).

Id. at 12-13.

B. The National and the Public Interest Do Not Require that Comsat

and the Common Carriers Be Protected from a National Non-Profit Corporation Transmitting Television Services via Satellite.

An analysis of the economic consequences to the carriers of the proposed non-profit corporation is contained in the Foundation's response to paragraph 4(c)(3) of the Commission's Notice of Inquiry. This section examines the legal framework that the Commission has established for considering these consequences.

The Commission exhaustively studied the effect of licensing private, non-common carriers for direct use of radio frequencies without going through common carriers in *Allocation of Microwave Frequencies Above 890 Mc.*, 27 F.C.C. 359 (1959), 29 F.C.C. 825 (1960) (reconsideration). The Commission's conclusions there apply equally here. "/P/ractical consideration of the economics involved would be a forceful deterrent to any large-scale diversion of common carrier business to private systems." 29 F.C.C. at 832 (1960). In fact, because of the enormous costs required to establish communication satellite systems this inquiry does not concern the possibility of as great losses to the carriers as the *Allocation of Frequencies* proceeding.

In the *Allocation* dispute the Commission rejected the carriers' plea for economic protection.

> It is abundantly clear that there is no *express* obligation on the part of the Commission under the Communications Act of 1934 . . . to protect the users of common carrier service from any adverse economic effects that the carriers might suffer in that connection.
>
> . . . .

> [T]he public interest would not be served by a policy of restricting or denying the licensing of private point-to-point systems solely because common carrier facilities are available or may become available in the reasonable future. It follows that the Commission should not consider the availability of common carrier facilities as a condition of eligibility for private users.
>
> . . . .
>
> Even in areas where common carrier facilities and personnel are readily available, there appears to be a need for private systems. . . . [S]uch private systems would provide for better control and flexibility for meeting their own hour-by-hour operational and administrative needs.

27 F.C.C. at 411-13. (Emphasis in the original.)

> [T]he establishment of private communication systems will result in the loss to the carriers of some message toll and private line revenues represented by some of the traffic which would be handled over such private systems. It is another matter, however, to conclude that the probable economic losses will be of such a nature and magnitude, when viewed in relation to the total resources and communications market of the communications common carrier industry, as to impair the ability of the industry to furnish an adequate nationwide service at reasonable charges. . . .
>
> [T]here is every reason to believe that message services of the Bell System will continue to provide its life blood and raison d'etre. . . . Accordingly it would appear reasonable to anticipate that any losses of message toll and private line revenues that the Bell System may incur because of the establishment of private communications systems will be more than offset by the revenues that will accrue to the Bell System in the normal course of development of its other sources of revenue.
>
> . . . .
>
> We doubt that our proposed policy of liberalized licensing of private communications systems will be economically destructive to . . . the common carrier industry, because, as a general rule, a common carrier should be able to furnish a given quantum of like communication service more economically and efficiently than a member of the public who undertakes to do the job himself.

29 F.C.C. at 850, 852. See also Television Intercity Relay Stations, FCC Docket No. 11164, 17 Pike & Fischer R.R. 1621 (1958): Television broadcast station licensees authorized to operate their own private intercity relay facilities in spite

of the availability of common-carrier facilities.

The courts have applauded the Commission's refusal to "let its decision in the radio carrier field interfere with its responsibilities in the television broadcasting field." *Carter Mountain Transmission Corp. v. FCC*, 321 F.2d 359, 362 (D.C. Cir. 1963), *cert. denied*, 375 U.S. 951 (1963). In the Justice Department's opinion, if the Commission were overly to protect common carriers "competition would be distinctly lessened and monopoly encouraged."* *Allocation of Microwave Frequencies Above 890 Mc.*, 27 F.C.C. 359, 392 (1959). The Justice Department proposed "that the common-carrier concept be given as limited application as the terms of the Communications Act will permit." *Id.* at 393.

C. A National Non-Profit Corporation Transmitting Television Services via Satellite Would Have an Insignificant Effect on Common Carriers Compared with the Economic Hardship the Commission Sought to Prevent in the Authorized User Inquiry.

In the *Authorized User* proceeding, Docket No. 16058, the Commission announced that non-common carriers including the Government could obtain channels directly from Comsat only in "unique or exceptional circumstances," in order to prevent "serious adverse consequences" upon the well-being of the common carriers. Memorandum Opinion and Statement of Policy, at 15. The economic hardship to common carriers that the Commission acted to prevent in Authorized User must be distinguished from the considerations involved in the present inquiry.

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* The Communications Satellite Act of 1962 did not purport to give Comsat a monopolist's protection for all communications-satellite activities. The corporation has such protection with respect to the space segment of the international system. By the terms of the 1962 Act, however, "the activities of the corporation . . . shall be consistent with the Federal antitrust laws." (Section 102(c).) And the Commission has been sensitive to the dangers inherent in Comsat's position. In the *Authorized User* proceeding, for example, the Commission emphasized the potential harm if Comsat abused "its monopoly position" in international satellite communications. Memorandum Opinion and Statement of Policy, FCC Docket No. 16058, at 11.

First, the Authorized User proceeding was concerned primarily with international communications, an area of special sensitivity because of the economic condition of the international record carriers. Excerpts from the Commission's Memorandum Opinion and Statement of Policy in the Authorized User proceeding reveal its concern for these carriers:

> /T/he loss of /overseas revenues from leased circuits/ could come close to wiping out completely the record carriers' earnings, unless the facilities could be immediately used for other services and produce substantial revenues, which appears unlikely.

Id. at 16. The financial well-being of the international carriers is not at issue, however, in the present inquiry since it concerns only "specialized domestic communications requirements." Notice of Inquiry, para. 4(a).

Second, if non-common carriers had been declared authorized users, Comsat would have been in direct and continuous competition with the common carriers, wooing away their major customers. The proposed national non-profit corporation transmitting radio and television services via satellite would not compete at all with the carriers in this sense but would at most divert an insignificant portion of their business from them. Thus, the competitive-injury problem to be considered here is not that of the Authorized User inquiry but rather that of the Allocation of Frequencies Above 890 Mc. proceeding, supra.

Finally, as shown in the previous section, authorization of the proposed services would have no impact on the common carriers' preponderant source of income -- message revenues. The Authorized User proposals -- especially the proposal for Comsat to furnish channels directly to the Government -- would have resulted in significant erosion of the common carriers' essential message services.

When a proposed service is plainly in the public interest (as is expansion of educational television by use of communications satellites) the burden of demonstrating adverse economic effects is on the carriers. Allocation of Microwave Frequencies Above 890 Mc., 29 F.C.C. at 854-55, 849; Microwave Communications Inc., FCC Docket No. 16509-16519, 6 Pike & Fischer R.R. 2d 952, 958 (1966).

Conclusion

We have shown that the Commission has the power under the 1934 Act to authorize private non-common carriers to construct and operate communications satellite facilities to meet their specialized domestic needs and that neither the 1962 Act nor the 1964 International Agreements removed this power. We have also shown that authorization for the service proposed by the Foundation would meet the tests of "public convenience, interest, or necessity" under the 1934 Act and "required in the national interest" under the 1962 Act. The Commission should thus view its statutory and regulatory powers as permitting authorization of that service.

Respectfully submitted,

The Ford Foundation

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FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C. 20554

In the Matter of the)
)
Establishment of domestic non-common) DOCKET
carrier communications-satellite) NO. 16495
facilities by non-governmental entities.)

COMMENTS OF THE FORD FOUNDATION IN RESPONSE TO THE COMMISSION'S NOTICE OF INQUIRY OF MARCH 2, 1966, IN THE ABOVE-ENTITLED MATTER

August 1, 1966

The Ford Foundation
New York, New York

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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THE FORD FOUNDATION
477 MADISON AVENUE
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McGEORGE BUNDY
PRESIDENT

August 1, 1966

Dear Mr. Chairman:

I have the honor to submit herewith a statement from the Ford Foundation which responds to the invitation of the Federal Communications Commission for "the views and comments of interested parties" on "proposals for the construction and operation of communications satellite facilities" by others than recognized common carriers. I am also addressing this same letter to each of the other Commissioners.

In this covering letter I want to summarize our conclusions -- and also to explain informally the deep concern which moved us to make the studies which have led to this submission.

First, I note that the Ford Foundation has no commercial interest and no operating interest in this matter. We exist for the purpose of giving money away -- as wisely and constructively as we can. This is the source of our deep interest in the present question.

We have a wider and longer experience of the effort to establish effective non-commercial television than any other single institution in the country. We have been by far the largest single source of funds for this effort. We have fifteen years of experience. We have made grants, directly and indirectly, of more than a hundred million dollars; currently we are making additional grants at the rate of more than ten million dollars a year.

From this experience we have learned three lessons:

(1) The first and most important lesson is that non-commercial television has unlimited potential, for human welfare and for the quality of American life. The best achievements of the best existing stations are proof enough -- but there is still more powerful evidence in the best achievements of the best services abroad. And the most powerful evidence of all is in the all-but-unanimous conviction of the ablest men in American television today: that nothing is more needed -- for television itself as well as for the country -- than a first-rate national non-commercial service.

(2) The second lesson is that existing services, and existing means of support, cannot hope to develop more than a fraction of this potential. The existing systems are much better than nothing. Compared to what this country deserves, they are a depressing failure. This is not the fault of the talented and dedicated men who have worked their hearts out for non-commercial television. It is the fault of all of us -- in that we have not yet found a way to give this work the resources it needs. It can well be argued that we at the Ford Foundation have contributed to this failure. When we give $6,000,000 a year to the National Educational Television and Radio Center (NET), we seem to have done a lot. And for us it *is* a lot -- it is our largest continuing annual grant. But the brutal fact is that our big gift is much too small.

(3) The third lesson follows from the first two: it is that the nation must find a way to a wholly new level of action in this field -- one which will release for our whole people all the enlightenment and engagement, all the immediacy and freedom of experience which are inherent in this extraordinary medium and which commercial services -- as they freely admit -- cannot bring out alone.

These three general conclusions are broadly shared, I believe, among all who have studied this problem -- by leaders in the Congress, by the members and staff of your Commission, and by independent experts. They underlie the establishment last year of a distinguished Commission of private citizens to study the future of non-commercial television, under a charge from the Carnegie Corporation and with encouragement from President Johnson. Under the chairmanship of Dr. James Killian that Commission is working hard to produce a prompt and constructive report. It will be good if we can avoid major decisions affecting the future of educational television until we have the benefit of the Carnegie report. A decision limiting the ownership and operation of communications satellites would be such a decision -- and *on this ground alone* the Commission would do well to avoid any ruling of this sort at this time.

But there are legitimate and important interests which are pressing for early decisions. The Ford Foundation can well understand the forces that could lead some to argue that great commercial questions should not be delayed for months while everyone waits for "one more report" on the future of educational television. Because the Carnegie Commission is still at work, it is not in a position today to contest this point in detail. Yet it has seemed to us a matter of high importance that the public interest in the future of non-commercial television be fully and properly represented in the pleadings before your Commission. This is what our submission aims to do. Our right to present this view is the right of any element in our society to be heard. Our duty to do it grows from experience, expenditure, and the terms of our Foundation's charter.

This right and this duty are made doubly urgent because of the promise that satellite communications may permit a revolution both in the technology and in the economics of television. Intensive exploratory studies have convinced us at the Ford Foundation that these revolutionary possibilities offer the promise of building a cost-free highway system for multiplied regional and national non-commercial services -- and also of providing a large part of the new funds which are desperately needed for non-commercial programming at every level.

The model we present is one way, not the only way. We are sure it can be improved by public study and comment. The state of the art is changing so fast -- and we have had so much to learn since March 2 -- that we are sure our present design can be improved by criticism. For this reason alone we would welcome hearings on this whole subject. And on wider grounds we are sure that any major restrictive action taken without hearings would be offensive to the public sense of fairness.

While the financial needs of educational television are widely recognized, the sources of the needed funds have been elusive. With the shining exception of the Educational Television Facilities Act of 1962, the Federal Government as a whole has stood to one side (and the Act of 1962, with all its generosity and foresight, carries a total appropriation which is lower than the funds spent by the Ford Foundation alone in the years since the Act was passed). Moreover, Americans are understandably cautious about direct Federal financing of channels of communication to the public. A number of additional remedies have been suggested, and we must hope for more light on this from the Carnegie Commission, but the hard fact is that up to now no remotely adequate solution has been found. We all want educational television to be properly funded. We do not want the Government to "pay the piper and call the tune." We are looking for an answer.

And that is what makes the possibilities of satellites so extraordinarily important. Non-commercial television has two great needs: first, to become a true national network, at a cost it can afford -- and second, to have money for programming, at a wholly new level of excellence. Properly used, a television satellite can meet both needs. By its natural economic advantage over long landlines, it can effectively eliminate long-distance charges as a determining element in network choices -- commercial and non-commercial alike. And if in the case of commercial networks a major share of these savings is passed on to the non-commercial programmers, then both problems are on the road to solution, and everyone is better off than he was before. This is not magic, or sleight-of-hand. It is a people's dividend, earned by the American nation from its enormous investment in space.

We are far from contending that a portion of the savings of the commercial users will pay for every possible program tomorrow. In our formal submission we estimate that such a system might produce $30 million a year for ETV programming almost at once, and perhaps twice that much within ten years. This is more than enough to start the revolution we seek -- and there would be still more in the future.

And all this, our analysis suggests, should be accompanied also by a wholly new level of investment -- public and private -- in the programs of live *instruction* that the satellite system invites. The satellite, used in the right way, can make the desert bloom for whole new areas of television. We do not claim that our way of doing it is the best. We do believe the best way must be found.

One cause of questioning may be the initial human effort of establishing a service of the sort that we suggest. Where can we find the first-rate men for a new non-profit venture? We have considered this question, and we have asked a number of the best professionals for their opinion. Their verdict is unanimous. We are talking here about a vision of excellence for the life of all Americans. Good men will want to work for it. We are convinced the signal of approval for a system like this one would release a rush of talent for the leaders of the new enterprise.

There is also a question of money. Once it is started, the enterprise will surely pay for itself and for much good besides. But who has the money to get it off the ground? That is a fair question, but we are convinced that there are good answers -- in the resources of the commercial networks, in the lending power of those who know a sure success when they see it, and in the resources of those who hold the view that money which helps to turn this corner will be money well used for the quality of American life. Our own commitment to this general purpose is clear.

We fully recognize the legitimate and reasonable needs of others who are concerned with satellite communications. We are convinced that our proposal does no significant harm to the legitimate and recognized interests of Comsat or the common carriers. With or without added responsibility for domestic television, Comsat will remain an unusually privileged commercial enterprise -- a prime and protected investment with exclusive chartered rights in international satellite service. Comsat faces international horizons which can engage its full energies for decades to come. The prosperity of *all* does not require for *any* a monopoly of the space communications available to the American people. And for the common carriers the revenue presently at issue is less than 1% of a business which grows by more than that in every season of every year.

For all these reasons, we believe the door to a new and separate broadcast satellite service must not be closed. We do not now present a formal application. We think it right to wait for the report of the Carnegie Commission, and we also believe that the Ford Foundation should not undertake alone the framing of a formal application in a matter which relates to the interests and concerns of all Americans. What we have done initially is to develop one possible model of a solution. We have tested it for technical feasibility with the professional counsel of Dr. Eugene Fubini of the International Business Machines Corporation. We have tested it against the laws with the help of Mr. David Ginsburg of Washington. We have tested its economic validity with the advice of Dr. Paul MacAvoy of the Massachusetts Institute of Technology. We have tested it against the realities of television programming with the help of Mr. Fred Friendly, our Advisor on Television. We have tested it against our own experience in the philanthropic support of non-commercial television. We think this model is sound against all these tests. But our purpose in presenting it is not to ask the Commission to grant a license now, to us or to anyone else. Our immediate purpose is rather to urge the Commission to take no action now that would foreclose these possibilities.

We think the Commission should invite a more formal proposal from the widest possible public. We think such a proposal would be forthcoming. We think it would be compelling. We would be glad to join with others to present it. All that we feel it right to do today is to enter the strongest possible argument against any action that would close the door to this new hope for all Americans.

In summary, our underlying purpose is not to press for a particular solution, and still less to interfere in any way with the legitimate interests of others. Our purpose is to stress four fundamental propositions:

(1) the critical importance to American life of properly designed domestic communications satellite systems;

(2) the very great -- and largely unstudied -- potential of such systems for non-commercial television and for education in its widest sense;

(3) the possibility that the management of this new national resource and the rates charged for its use can be arranged in such a way as to provide adequate resources for a wholly new level of service to the American people; and

(4) the desirability of most careful deliberation before national decisions are reached with regard to the assignment of responsibility in this area.

This is a time for due process, and for greatness.

Sincerely,

McGeorge Bundy

The Honorable Rosel H. Hyde
Chairman, Federal Communications Commission
Washington, D.C.

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C. 20554

In the Matter of the Establishment of domestic non-common carrier communications-satellite facilities by non-governmental entities.	)	DOCKET NO. 16495

COMMENTS OF THE FORD FOUNDATION IN RESPONSE TO THE COMMISSION'S NOTICE OF INQUIRY OF MARCH 2, 1966, IN THE ABOVE-ENTITLED MATTER

The Ford Foundation
New York, New York

August 1, 1966

Volume One

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Comments on Paragraph 4 (a) are contained in Volume Two, a separate legal brief; for convenience, the Foundation's comments on Paragraph 4 (b) are incorporated in Volume Two.

I.

STATEMENT OF THE INTEREST OF THE FORD FOUNDATION IN THIS PROCEEDING

Since 1952 the Ford Foundation has made grants of more than $100 million to educational television, and its current rate of grant-making for this purpose is more than $10 million a year.

After the Federal Communications Commission lifted its allocation freeze on channels for educational television in the early 1950's the Foundation initiated a series of grants

- to help build and equip stations
- to stimulate educational, citizen, and broadcaster support
- to create and finance a program distribution agency.

Through experiments and demonstrations in television the Foundation sought ways to improve the quality of teaching and to extend the reach of superior teachers. It did this through support of ETV stations and of other educational institutions in presenting school and college lessons, courses, and other educational materials on closed-circuit systems, ETV stations, and commercial stations and networks.

Since 1956 the Foundation has provided additional financial assistance

- for a national program in the use of television in the public schools
- for the Hagerstown experiment in multi-channel closed-circuit school use of television
- for college-level courses on commercial networks

- for released time of faculty members to prepare and present televised college courses to regularly-enrolled residential students, and
- for an experiment in airborne television which encompasses seven Midwestern states.

The Foundation has also provided continuing support for the National Educational Television and Radio Center (NET) as a program acquisition and distribution agency and as a national programming center.

But though the National Educational Television and Radio Center and the educational television stations throughout the country have performed valiantly, the facts are that 1) the lack of interconnection has been a grave handicap, and 2) support for educational television to date has been woefully inadequate. For the future, much greater financial aid, beyond the resources of the Ford Foundation, will be required if educational television is to reach its potential.

Because of its longstanding interest and substantial investment in educational television, the Ford Foundation is not only concerned about the future of educational broadcasting in this country but is deeply interested in the impending advances through communication satellites and the extraordinary possibilities the new technology portends.

Satellite communication is a new field, and its full possibilities are still incompletely understood. We are certain only that the range of possibilities is extraordinary, that the capabilities will be vastly higher and the costs vastly lower than anything we have known before in long-distance communication, and that these technological advances will have large implications for the quality of human life.

These possibilities can become realities. A way of achieving this goal is to establish a new National Non-Profit Radio and Television Satellite Distribution Service -- a system subject to full Commission regulation and to other appropriate safeguards. The facilities of the new system would be used for the distribution of non-commercial and commercial television and radio broadcasting. Such a service could provide a cost-free network tie-up for national non-commercial television, and it could also generate a large part of the revenue needed for more effective non-commercial programming, both regional and national. It could, in short, provide the missing link between what we now have and a first-rate American non-commercial television system.

Such a non-commercial television system, in turn, could provide a spectrum of informational, cultural and instructional services as wide and deep as knowledge, wisdom, talent, and imagination permit.

The informational service could include:

. Full and live coverage of significant hearings and debates.

. Interpretation of news.

. Interviews and discussions featuring outstanding leaders in all fields.

. Documentaries on important international, national, regional, and local problems.

. Live and filmed reports designed to give the American people a better understanding of the three branches of government at all levels.

. Broadcasting coverage of national and local political campaigns, including free time, under appropriate safeguards, for candidates for political office.

The *cultural service* could include:

- Musical, dramatic, and literary events of high quality from any location in the country.
- Programs featuring established works and artists as well as important new works and promising young artists.
- Broadcasts covering the whole range of the humanities.
- Special events, such as the opening performance of the Metropolitan Opera season, the premieres of important new symphonic works, plays presented in regional theaters as well as on Broadway, and performances direct from Lincoln Center, to name but a few.
- Programs on the cultural life not only of this country but of nations throughout the world.
- Program series devoted to the history of the United States and to the history of American institutions: the Presidency, the Supreme Court, the Congress, the public school system, the military establishment, the university.
- Programs of quality and taste for children.

The *instructional service* could include:

- Live instructional programs for an aggregate of 60 million students at all levels of education, with a new immediacy of communication between teacher and student.
- Instructional materials which could be stored on tapes in schools, colleges and universities, and school system centers.
- Special broadcasts of public events of special interest to students at a particular level or at all levels.
- In-service training of teachers.

The new system, designed and operated to serve the public interest, could provide many important benefits to the American people, among them the following:

- *The people would have a wider choice.*

On the one hand, the commercial networks would continue to provide the full gamut of mass entertainment, programs which millions of Americans enjoy watching. At the same time, there would be available through an effective "second force" in broadcasting a continuing flow of cultural events, information, interpretation, and community service programs -- all of these available to the people who choose to watch.

- A substantial amount of the programming would be live.

The greatest assets of television are liveness and immediacy. A live program gives a viewer a sense of involvement. It is more likely to engage his intellect and his senses. He feels that "he is there." The economics of television have mercilessly diminished live programming to a bare minimum. Much of the vitality has been drained out of television with the increasing use of tape. Through transmission by satellite, liveness and immediacy in informational and cultural broadcasting would be economically feasible.

- Informational and cultural programs would be broadcast during prime time.

With rare exceptions in the past decade, the prime evening hours in television broadcasting have been reserved for mass entertainment purposes. For the first time, through an effective non-commercial network made possible by the satellite, outstanding informational and cultural programs could be broadcast regularly throughout the evening hours -- a period when a real viewing choice exists for millions of Americans.

A description of the proposed system follows.

II.

BROADCASTERS' NON-PROFIT SATELLITE SERVICE (BNS): DEFINITION, SERVICES, COMPONENTS AND COSTS

A National Non-Profit Radio and Television Satellite Distribution Service

The essence of this proposal is the creation of a non-profit corporation authorized by the Commission to establish communication satellite facilities for transmission of commercial and non-commercial television and radio broadcasting. For convenience and simplicity the suggested title is BROADCASTERS' NON-PROFIT SATELLITE SERVICE (BNS). But the subtitle is also important in giving precision to the description of the proposed undertaking: " A National Non-Profit Radio and Television Satellite Distribution Service." Each term of this subtitle deserves a brief definition.

National: This service would be national in the sense that it would be designed to serve all within the borders of the United States with access to radio and television sets. It would have ample provision for regional programming and distribution, and it would be open also to international exchange using established international communication services. It would aim to open new opportunities to all kinds of program designers, commercial and non-commercial -- those already established and those yet to be founded. The system would be national, in short; but in the most inclusive and pluralistic sense of the word.

Non-Profit: The proposed corporation would be a non-profit entity with a Board of Trustees representative of the public and private interests involved.

It would be recognized as the joint effort of the commercial and the non-commercial institutions engaged in broadcasting. It would be authorized by its charter to collect revenues from the broadcasters; in particular, it would be expected that duly qualified non-commercial broadcasters would be given free access to the satellite distribution system. It would be further provided that a major purpose of the corporation would be to generate from its commercial users substantial funds to be assigned by its Board of Directors for non-commercial programming, both national and regional.

Radio and Television Satellite: The satellites in this service would be used exclusively for the transmission of programs intended for open distribution to television and radio audiences. Such audiences would be found both in homes and in schools. They would be large and small. But they would be radio and television audiences -- not the receivers of private messages or communications. The system is thus sharply distinguished from the transmission of messages or data or other information from a specific originator to particular addresses; such service is the proper business of general common carriers.

Distribution Service: These words distinguish the proposed system from broadcasting direct to radio and television sets. What is here proposed is a system of transmission from a limited number of sending stations via satellites to a limited number of ground stations for onward transmission to radio and television sets (a possible exception would be the authorization of roof-top antennae on schools and colleges for instructional transmission). The initial users of this system would be existing commercial and non-commercial radio and television stations, and the ground receivers under their control would be a necessary part of the satellite distribution system.

The services thus defined are translated into a technical system in Table 1, "Broadcasters' Non-Profit Satellite System - A Representative Near-Term Configuration" (BNS-1). This table sets forth a system of unprecedented broadcasting breadth. It would provide a wholly new order of service -- six channels in each of four time zones for the commercial networks and five non-commercial channels in the same four time zones. Of these non-commercial channels, one would be for informational and cultural TV aimed primarily at the home, and four would be for instruction at all levels from grade school to graduate school. Speaking generally, and with due regard for differences in specific capability, BNS-1 is ten times as powerful as the existing network of landline connections used for broadcast distribution.

The system thus outlined is designed to open the way for the broad range of services discussed in the preceding section. We will not understand it well if we relate it only to what now exists. It is a highway for the commercial, cultural, and educational transmission of programs of the future -- designed to show what television can become and not simply what it now is.

Table 1 shows the costs of initial installation and the costs of operation and maintenance of the first configuration. The table also includes estimated charges for depreciation and interest, although it is certainly conceivable that initial financing might be arranged so that such charges would be at least partly inapplicable. What is most interesting about this first system is the wide difference between its total annual cost of $19.3 million and the current charges of $65 million for existing more limited commercial facilities.

Table 2 outlines a more expansive system, larger by twenty channels. This larger system would permit transmission of a much wider range of instructional materials. The annual costs of this second system are less than $3 million larger than for BNS-1, and we include this larger design to show the very wide possibilities for low-cost, large-scale transmission of educational materials. Such a wider system could readily transmit flexible teaching programs designed for the use of teachers and learners of many different kinds, all the way from the first grade to the graduate seminar.

What we have not charted -- because estimates are more uncertain and because sources of support are even less defined -- is the capital cost and operating expense of the programming that would occupy these new noncommercial channels. Our broad estimate is that capital expenses on the order of $50 million would provide for about four regional programming centers, and that the annual operating expenses of such programming centers -- all in the field of cultural and informational programming for the home -- might be on the order of $60 million a year. We believe a major part of these expenses can be met from the difference between the present payments of the commercial networks to the telephone companies and the payments for BNS-1. Simply for illustration, let us suppose that two-thirds of this difference was contributed towards the cost of cultural and educational programming. The difference between the annual cost of BNS-1 and 1965 toll line payments, with allowance for continued use of some ground facilities, is $45 million, and two-thirds of this difference would be $30 million. By 1975, on a pro-rata basis for additional channels in use, total payments might exceed $60 million a year. Given the fact that time will be needed for the development of effective programming services, we do not see any fundamental imbalance between these prospective resources and the requirements of the new service.

The problem of effective instructional programming is different, and our initial view is that it should be separate. The responsibility for the costs of education is fundamentally a responsibility of taxpayers at every level -- it is not a matter of the shared responsibility of network broadcasters. Measured against the overall costs of $39 billion per annum for education in this country, the necessary new resources -- which may be on the order of $65 million a year for BNS-1 -- are quite literally trivial. Yet small as the sum is, our initial analysis suggests that about one-third would need to come from new appropriations -- probably at the Federal level.

TABLE I

TABLE 1: BROADCASTERS' NON-PROFIT SATELLITE SYSTEM
A REPRESENTATIVE NEAR-TERM CONFIGURATION (BNS-1)

SYSTEM DESCRIPTION

Services provided in each of 4 continental time zones

1) Commercial broadcasting---------- 6 channels
2) Instructional TV ----------------- 3 channels for primary-secondary schools
   1 channel for university
3) Cultural and Informational TV------1 channel

Time Zone Total --11 channels

Total services of 44 channels for the continental United States

System components

1) Sending stations

   Mobile ----------------------24 stations each with 1-channel capacity from a 15-foot antenna

   Fixed ----------------------12 commercial stations, each with 6-channel capacity from 60-foot antennae

   8 educational stations of the same quality as the commercial stations

   500 special stations, each with 1-channel capacity for use in providing 2-way communication to the receiving stations

2) Satellites — 4 satellites, each with capacity to distribute 12 channels of color TV. Each channel has a bandwidth of 40 megacycles. Total BNS channel capacity is 48 channels, 44 active and 4 spares. Transmission is in the 3700-4200 MC/S band.

3) Receiving stations — 750 stations for reception at the broadcast stations for re-broadcast in local area. Each station has a 15-foot antenna, low-noise amplifiers, FM conversion equipment and other related electrical equipment suited to such stations.*

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* Although not a part of this system, remote school systems might add antennae and related equipment to receive instructional television from the satellite for re-broadcast over closed circuit. The technical discussion in 4(d) considers the addition of 1000 remote antennae as a supplement to BNS-1.

BROADCASTERS' NON-PROFIT SATELLITE SYSTEM (BNS-1)

ITEMS	CAPITAL COSTS (million $)	ANNUAL COSTS (million $)		
		Operation and Maintenance	Depreciation and Interest**	Totals
1) Sending stations				
24 mobile stations	1.8	0.3	0.3	0.6
20 fixed stations	8.0	2.0	1.0	3.0
500 special stations	5.0	0.4	0.6	1.0
2) Satellites				
R&D	10.0	-	1.3	1.3
4 satellites***	25.2	0.5	5.7	6.2
3) Receiving stations				
750 station antennae and related equipment	30.0	0.4	3.8	4.2
4) Estimated administrative costs		3.0	-	3.0
Totals	80.0	6.6	12.7	19.3

** The interest and depreciation are calculated on the following basis: the interest charge is five per cent per year on the undepreciated balance; depreciation takes place over a five-year period for the satellites, and over a ten-year period for all other components.

*** Satellite cost per channel is halved by limiting service to continental United States, as proposed. An additional satellite could be introduced which would provide 12-channel service to Alaska and Hawaii. The capital cost of this supplementary service would be $6.3 million, the cost of the satellite; the annual cost would be approximately $1.4 million.

TABLE 2

TABLE 2: BROADCASTERS' NON-PROFIT SATELLITE SYSTEM: A REPRESENTATIVE EXPANDED CONFIGURATION (BNS-2)

SYSTEM DESCRIPTION

Services provided in each of 4 continental time zones

1) Commercial broadcasting -------- 6 channels
2) Instructional TV ---------------- 7 channels for primary-secondary schools
   2 channels for university
3) Cultural and Informational TV ----- 1 channel

Time Zone Total -- 16 channels

Total services of 64 channels for the continental United States

System components

1) Sending stations

   Mobile -------------------- 24 stations, each with 1-channel capacity from a 15-foot antenna

   Fixed -------------------- 12 commercial stations, each with 6-channel capacity from 60-foot antennae

   16 educational stations of the same quality as the commercial stations

   500 special stations, each with 1-channel capacity for use in providing 2-way communication to the receiving stations

2) Satellites — 6 satellites, each with a capacity to distribute 12 channels of color TV. Each channel has a bandwidth of 40 megacycles. Total BNS channel capacity is 72 channels, 64 active and 8 spares. Transmission is in the 3700-4200 MC/S band.

3) Receiving stations — 750 stations for reception from satellites at receiving stations for re-broadcast in local area. Each station has a 15-foot antenna, low-noise amplifiers, FM conversion equipment and other related electrical equipment suited to such stations.*

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* Although not a part of this system, remote school systems might add antennae and related equipment to receive instructional television from the satellite for re-broadcast over closed circuit. The technical discussion in 4(d) considers the addition of 5000 remote antennae as a supplement to BNS-2.

BROADCASTERS' NON-PROFIT SATELLITE SYSTEM (BNS-2)

ITEMS	CAPITAL COSTS (million $)	ANNUAL COSTS (million $)		
		Operation and Maintenance	Depreciation and Interest**	Totals
1) Sending stations				
24 mobile stations	1.8	0.3	0.3	0.6
20 fixed stations	8.0	2.0	1.0	3.0
500 special stations	5.0	0.4	0.6	1.0
2) Satellites				
R&D	10.0	-	1.3	1.3
6 satellites	37.8	0.5	8.6	9.1
3) Receiving stations				
750 station antennae and related equipment	30.0	0.4	3.8	4.2
4) Estimated administrative costs		3.0	-	3.0
Totals	92.6	6.6	15.6	22.2

** The interest and depreciation are calculated on the following basis: the interest charge is five per cent per year on the undepreciated balance; depreciation takes place over a five-year period for the satellites, and over a ten-year period for all other components.

III.

RESPONSE OF THE FOUNDATION TO PARAGRAPH 4(c) OF THE NOTICE OF INQUIRY

The question here addressed is the following:

"4(c) Whether, as a matter of policy, it would be in the public interest to grant such authorizations considering:

(1) The amount of frequency spectrum now available for the communication satellite service under the Commission's Rules;

(2) The extent to which terrestrial facilities are or may be available to provide the services contemplated;

(3) The potential economic effects on common carriers; and

(4) The potential benefits (e.g. improved quality and reduced cost of service) which might result from the grant of such authorizations."

Paragraph 4 (c)

(l) The Amount of Frequency Spectrum Now Available for the Communication Satellite Service under the Commission's Rules

The frequency spectrum now available for communication satellite service under the Commission's Rules is (1) the frequency band 3,700 to 4,200 megacycles for the down-link, and (2) the frequency band 5,925 to 6,425 megacycles for the up-link. *

BNS would transmit commercial and non-commercial television via satellite. The issue here is whether, considering the available spectrum, it is in the public interest to authorize television transmission via satellite on the scale proposed. Who will own and operate the satellite facilities is not relevant to this issue. It is clear to us: (1) national television will be transmitted via communication satellite, whether by BNS or in some other way; (2) it is in the public interest that this be so; and (3) the amount of spectrum allocated to communication satellite service is more than adequate for television and other foreseeable demands that may be made upon the spectrum. A few calculations will illustrate the last point.

The variables controlling the quantity of communications that can be transmitted via satellite in the available spectrum are the accuracy with which satellites can be placed and controlled in orbit and the size, pointing accuracy, and tolerance of ground antennae. It is now estimated, conservatively, that

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* See also technical data contained in 4(d), infra.

satellites can be placed in equatorial orbit at intervals of approximately three degrees without interfering with each other. On this basis, 25 satellites could be placed in a band of 72 degrees, visible from Maine to California. Current technology will permit the ground antennae to discriminate between two adjacent satellites.

Twenty-five satellites, each with 12 television-quality channels, would provide a total capacity of 300 such channels, or 288,000 one-way voice channels. These figures are conservative and actual capacity could be greater, but they do illustrate the orders of magnitude. The maximum configuration in BNS-2 of 64 channels would still leave more than 200,000 one-way voice channels for other communication satellite services.

Paragraph 4 (c)

(2) The Extent to Which Terrestrial Facilities Are or May Be Available to Provide the Service Contemplated.

BNS-1, the smaller of the two configurations, would provide 44 channels of nation-wide television distribution for commercial and non-commercial use. Existing terrestrial facilities are not sufficient to accommodate this service. They could be expanded, but the cost of providing 44 channels of nation-wide television by terrestrial facilities would be prohibitive.

Terrestrial services now provide approximately 9 channels of nation-wide television for commercial purposes. There are 115 non-commercial television stations, but these are not interconnected to provide nation-wide non-commercial television. Although precise cost data are not available, an extrapolation based on present costs suggest the dimensions of the problem. The three commercial networks now pay approximately $45 million annually for the visual component of 9 channels of nation-wide television. The audio component of television plus radio distribution amount to another $20 million, making a total of $65.4 million paid in 1965 for radio and television distribution. See 4(c)(3) below. In response to an inquiry from the Foundation, the Long Lines Sales Division of AT&T estimated that more than three but less than six channels of national ETV would cost approximately $18 million annually. On this basis, 44 channels would cost roughly $200 million a year. *

In contrast, the 44 channels of nation-wide television provided by BNS would cost $19.3 million annually (this figure includes depreciation and interest and operating and maintenance expenses).

Moreover, the quality of television via satellite will be better, at least with respect to color television. A satellite system with only a single repeater introducing phase error provides the potential for improved color quality.

Finally, the issue goes beyond comparative costs or quality. No way has yet been suggested of organizing the distribution of commercial services via

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* This figure does not reflect cost savings per channel that might result from increased use of terrestrial facilities. But there is no reason to believe that such savings, if there were any, would reduce the totals sufficiently to affect this analysis. Moreover, the cost data used here are conservative in three respects: (1) they do not include the audio component of commercial television; (2) they assume service of roughly 16 hours a day rather than a full day; and (3) each network has been credited with the equivalent of three simultaneous nation-wide channels; in fact, only one channel of nation-wide television can be provided at a given time by a network -- the three channels are for simultaneous regional distribution.

terrestrial facilities in a way that generates revenues for non-commercial television. Even if the cost of terrestrial facilities were greatly reduced, they would greatly exceed the funds available for non-commercial television. Satellite technology offers the opportunity to organize a system that will generate the revenues needed to provide nation-wide non-commercial television.

Paragraph 4(c)

(3) The Potential Economic Effects on Common Carriers.

Program material for the broadcasting industry both audio and visual, is transmitted by Class A Telephone Carriers. BNS would affect these carriers only; no revenues would be diverted from record carriers, international or domestic.

In 1964, total revenues of the Class A Telephone Carriers exceeded $10.9 billion. Federal Communications Commission, Statistics of Class A Telephone Carriers Reporting Annually to the Commission As at December 31, 1964, and For Year Then Ended, Item No. 55. Of this amount, $62.4 million, or 0.57 per cent, were derived from transmission of audio and visual programs, including all non-commercial as well as commercial television and radio transmission.* (Id., Item Nos. 120, 121). At most, therefore, the service proposed here would divert from the Class A carriers a microscopic portion of their revenues.

The telephone companies transmit audio and visual broadcast materials as both a local service and a (long distance) toll service. BNS would not greatly affect the volume of local service but toll service revenues would decrease. It might be argued that diversion of revenues to BNS would result in an increased unit cost of providing service to other long line users.

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*Figures for 1965 have not been published, but preliminary estimates prepared by the Commission staff indicate that broadcasting revenues will be an even smaller percentage of total revenues -- $65.4 million out of $11.8 billion, or 0.55 per cent.

There are three answers to this argument.

First, if television distribution via satellite is more efficient than the use of existing long lines -- and it seems clear that it is -- this service will be provided, whether by BNS or a common carrier. The diversion of revenues thus follows not from anything unique to BNS but from the economies inherent in satellite technology.

Second, any reduction in toll private line services would be negligible since audio and visual transmission account for a small proportion of the total service. The best indication of this is the revenues generated by various private toll services. Total toll private receipts ranged from $147 million in 1955 to $480 million in 1965 FCC statistics of Class A Telephone Carriers; 1965 figures are preliminary; but toll receipts from audio and visual transmission were only $44 million in 1955, and $65 million in 1965. The loss in revenues -- and, by implication, in the volume of private long line transmission -- would be less than 14 per cent of the total.

Third, any reduction would be more than offset by increased services for other long line users. AT&T has predicted that revenues from private long distance toll service will increase to $888 million in 1969 (FCC Docket No. 14650, Exhibit 17, Item B, testimony of Stanley Damkroger, assistant vice president, AT&T; the prediction is made by projecting the trend of message units, at constant 1961 rates, so that this revenue projection implies substantial annual increases in the volume of toll private services). An alternative prediction can be made. Total private toll receipts have increased at a rate of 11 per cent per annum during 1955-1965. If next year's increase is at the same rate, it alone will offset the total revenues now received from audio and visual transmission. The diversion of business will be compensated for by the growth of other services in a matter of months.

Furthermore, it is not clear that diverting broadcasting transmission from common carriers will have an adverse rather than a beneficial effect on their profits. Statistics submitted in FCC Docket No. 14650 indicate that broadcasting and related services barely pay their way. The ratio of net operating earnings to net investment for the Bell System averages 7.5 per cent. For message toll telephone, the ratio is 10 per cent. For television and audio transmission, experimental services, and other "miscellaneous" services together, the ratio is only 1.1 per cent -- roughly one-tenth the ratio for message toll telephone. FCC Docket No. 14650, AT&T Exhibits 80, 81. Unless there are higher returns not reflected in the method of reporting, these services are at best a marginal activity for the carriers. There is no reason to expect that the profit margin for these services will increase in future years. If the facilities now engaged for broadcast transmission were used for more lucrative services -- as they would be if BNS were established -- loss of broadcasting business might well have the net effect of increasing revenues.

Paragraph 4 (c)

(4) The Potential Benefits (e.g. improved quality and reduced cost of service) Which Might Result From the Grant of Such Authorizations.

(a) Social Benefits - The national television audience now includes virtually the entire population. This audience has access to the variety and quality of commercial programming that almost unlimited resources can provide, and it has access to three networks of national programming. On an average evening, the viewing audience for commercial television is roughly 100 million people.

In contrast, one-third of the nation's population does not even have access to educational television. During the prime evening hours, the viewing audience for educational television seldom exceeds three million people. Existing ETV stations are not interconnected regionally or nationally -- there is no "live" national TV network for non-commercial television.

Funds for imaginative and creative programming have been meager. NET, funded by the Ford Foundation, produces only five hours a week of new programs.

Total expenditures by an average educational television station in a year are far less than the cost of a single commercial television spectacular. And the total program cost of educational television stations throughout the country is roughly equivalent to the cost of one network series.

The growth of instructional television is no more encouraging. We know from experiments that television can be a powerful teaching device. We also know that the most imaginative ways to use the medium have yet to be explored.

There are now no national network facilities for instructional television, and relatively few independent services. Reliable statistics on the number of students exposed to instructional television, and the nature and depth of their exposure, are hard to come by, but it is clear that instructional television has affected only a fraction of the school and university population of the nation.

Potential benefits of BNS have been developed in Mr. Bundy's covering letter and in the Statement of Interest of the Ford Foundation in this proceeding. They lie in three areas: first, BNS could make non-commercial television available to every American, and with far greater channel capacity than exists now. Second, BNS would make available a national non-commercial television network rather than the separate, non-connected stations that presently exist. This is a benefit of great importance in a nation as large and heterogeneous as ours; commercial television has already demonstrated, most notably during the hours immediately following President Kennedy's assassination, the unifying force of national network television. With events less tragic and terrifying, that example can and will be repeated many times over. Third, BNS can generate funds for programming non-commercial television -- funds that are already scarce.

National non-commercial television produced with equipment of network quality, showing "live" programs produced by the most imaginative and creative people available, broadcast live during the prime evening hours -- this is the promise from innovation in telecommunication technology.

(b) Economic Benefits - The economic benefit of BNS can be measured by two yardsticks: First, the costs of television distribution via BNS compared with the present cost of television distribution; second, the costs via BNS compared with television distribution costs of broadcasting via a satellite service organized and operated in a different way. The cost figures for BNS-1 and BNS-2 are stated at Tables 1 and 2 in Chapter II above. These costs, for 44 or 64 channels of national television, are far less than the $65 million spent in 1965 for radio and television distribution on a much smaller scale.

Data which would permit comparison of BNS with equivalent television distribution via some other satellite system are not available. But there are certain to be significant economies in a system tailored to meet specific communication needs in the most efficient way. The distribution of television broadcasting is a specialized communication service. In contrast to virtually all point-to-point services and many multi-point services (such as the computer systems of central banks or airlines), it has no need for security or privacy. Thus, broadcasting distribution does not require costly switching and other equipment needed for other communication transmission services.

A satellite system for transmitting television programs would have a configuration and technical characteristics different from a multi-purpose system. The satellites might be larger, the ground stations smaller. The satellite repeater design could be simplified because all the information going through the satellite would be of the same type and it would be handled in large blocks. The ground environment would not have to be as tightly controlled as it would be for a system handling message units. Some of the technical problems of voice transmission, such as "time delay", would not arise.

A satellite system tailored to meet the special needs of television will be less costly and less difficult to provide than a multi-purpose system burdened by the requirements for message and data traffic.

No communication service can be provided economically by a separate satellite system unless it generates sufficient volume to pay the heavy capital costs required to initiate the system. That factor is not relevant here since there is sufficient requirement for television traffic to justify a separate satellite system, as the system configurations proposed for BNS-1 and BNS-2 demonstrate. Each of the three commercial networks has indicated a desire for a separate channel in each time zone. Assuming, for purposes of illustration, that there will eventually be six commercial networks, this requirement would generate a need for 24 commercial broadcasting channels. Relying on its own experience, the Foundation believes that for non-commercial broadcasting, not including instructional television, there is one channel need at least in each of four time zones. Instructional television can effectively use three channels for primary and secondary education and one for university education in each of four time zones. Non-commercial television can thus use a total of 20 channels, which gives a total requirement for television transmission of 44 channels.

(c) Early Availability - The benefits here sought can be realized within this decade. The satellite technology exists -- launch is possible within 18 months from the time a contract is let. Stationary high-powered satellites with directional antennae are required to reduce the unit cost of the earth stations. This technology has been demonstrated before. The necessary boosters have been developed and tested.

It is unlikely that equal speed can be achieved by a multi-purpose satellite system. The additional service requirements such a system will have to meet, and the additional technical parameters imposed upon it, will lead to delays at every stage in the organization and establishment of the system.

Another possibility -- providing domestic television distribution under the aegis of the International Consortium -- would lead to still further delays. The system configuration would have to be approved by many nations. Funding would be slower and procurement more expensive. The organizational structure would be more cumbersome.

(d) Competition - Our tradition calls for competition to exploit invention. The prod of competition will be a powerful force in making the technology of satellite communication generally available. Particularly with a technology as dynamic as satellite communication, it would be prudent to create conditions which reward the innovator.

(e) Commercial Networks TV Stations - BNS also offers a dividend for the commercial networks and the public they serve through swifter, more efficient, more economical service for their news and informational services. Every television station and its community could have immediate access to its network via the communications satellite and truck mobile stations which extend this capability to any point in the nation.

IV

RESPONSE OF THE FOUNDATION TO PARAGRAPH 4(d) OF THE NOTICE OF INQUIRY

---

1. Introduction

The specific questions in the FCC Notice of Inquiry which are here addressed are the following:

> "4d. Is it technically feasible to accommodate the space service contemplated, in light of the requirement:
>
> (1) That the power flux density produced at the earth's surface in the band 3700-4200 Mc/s by emissions from a space station employing wide-deviation frequency (or phase) modulation, not exceed -149 dbw/m^2 in any 4 Kc/s band for all angles of arrival, nor a total of -130 dbw/m^2 for all angles of arrival;
>
> (2) That the power flux density produced at the earth's surface in the band 3700-4200 Mc/s by emissions from a space station employing other than wide-deviation frequency (or phase) modulation, not exceed -152 dbw/m^2 in any 4 Kc/s band for all angles of arrival;
>
> (3) That earth stations receiving signals from space stations in the band 3700-4200 Mc/s be so located with respect to the existing common-carrier microwave complex in that band that they are not subjected to harmful interference from such terrestrial microwave systems;
>
> (4) That transmitting earth stations in the band 5925-6425 Mc/s:
>
> (a) Not exceed a mean effective radiated power of 45 dbw in any 4 Kc/s band in the horizontal plane; and
>
> (b) Not cause harmful interference to the existing common-carrier microwave complex in the same band."

As seen in Figure 1, questions 4d(1) and 4d(2) relate to the interference from the down-link feeding into the terrestrial microwave networks; question 4d(3), interference from the microwave network into the broadcast stations; question 4d(4), interference from the up-link into the microwave network. Since the representative BNS systems discussed earlier are based on wide-deviation frequency modulation, question 4d(2) is not applicable.

2. Summary Results

a. We find that it is technically feasible to accommodate the space service here contemplated under the presently specified restrictions as to power density.

b. We find that it is both technically feasible and economically desirable to moderate the power restrictions as applied to interference with the common-carrier microwave relay system.

3. Significance of Power Restrictions

In demonstrating the latter result, we shall consider first the effect of the -130 dbw/m^2 restriction on the cost of those components of the down-link equipment affected by satellite effective radiated power (ERP). The components whose costs are affected by ERP are the antenna, feeder, tuner, and demodulator in the Earth receivers, and of course the satellite itself. The increased costs of the more sensitive Earth receivers required under the restriction on total flux density may be offset only in part by the decreased cost for a satellite of lower ERP.

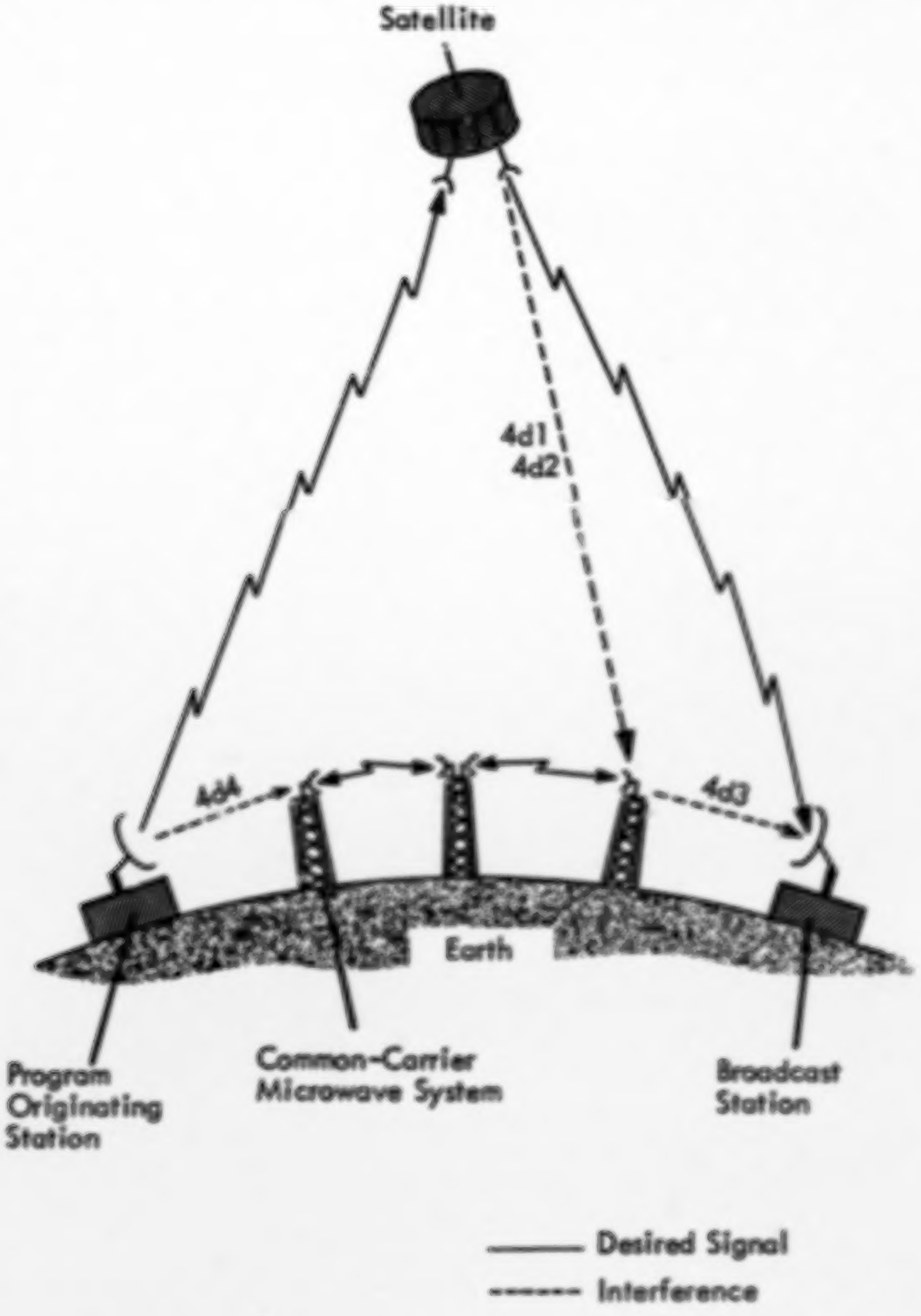

Satellite
4d1
4d2
4dA
4d3
Earth
Program
Originating
Station
Common-Carrier
Microwave System
Broadcast
Station
Desired Signal
Interference

Figure 1. Types of Possible Radio Interference

Two systems (BNS-1 and BNS-2), varying in both numbers of channels and receiving installations, as shown in Table 1, are considered under the present power restrictions as well as under moderated restrictions. If the restrictions are moderated as shown, the cost savings on BNS-1 will be \$3.4 million and on BNS-2, \$10.0 million. Thus, while the contemplated service can be provided so as to comply with the -130 dbw/m^2 restriction on total flux density, a moderation in this restriction may yield a savings on cost. The current meeting in Oslo of the Comité Consultatif International Radio (CCIR) Working Group IV has recommended abandonment of the 130 dbw/m^2 restriction on total flux density in favor of a spectral density limitation of $(-152 + \theta/15)$ dbw/m^2 per 4 Kc/s band, where θ is the angle of arrival. This moderation is sufficient to yield the savings indicated above.

The problem of type 4d(1) interference from the down-link feeding into the terrestrial microwave receivers is most acute when (to any given receiver) the satellite appears low on the horizon. This may occur when the receiver has its antenna directed so that the main beam intersects the synchronous equatorial belt. Because the elevation angle of most terrestrial microwave receivers is quite small, there is on that belt a "window" within which distribution satellites may be emplaced so as to benefit from the suppression of undesired signals incident on the side lobes of the receiver antenna.

Since the representative BNS systems can be operated so as to comply with the -130 dbw/m^2 restriction on total flux density, we now address the

Table 1. Comparison for BNS Representative Systems of Incremental Costs for Optimal System and for System Restricted to a Total Flux Density of -130 dbw/m^2

		BNS-1	BNS-2
Number of Satellites		4	6
Number of Active Channels (Channel bandwidth of 40Mc/s)		44	64
Number of receiving installations		1,750	5,750
Satellite ERP (dbw)	Restricted	31	31
	Optimal	37	37
Cost of Satellites* ($ millions)	Restricted	27.7	40.3
	Optimal	27.7	40.3
Cost of Receivers* ($ millions)	Restricted	7.0	20.0
	Optimal	3.6	10.0
Incremental System Cost* ($ millions)	Restricted	34.7	60.3
	Optimal	31.3	50.3
Savings with Moderation of Restriction ($ millions)		3.4	10.0

* These figures show that portion of the cost which varies with ERP

restriction on spectral density (i.e., -149 dbw/m^2 in any 4 Kc/s band). Figure 2 shows the spectral density tolerable for the receiver and the associated satellite ERP as a function of satellite longitude. The results are for a "worst case" condition of 5 degrees elevation of the microwave relay antenna. The window effect is evident as the difference in the tolerable spectral density (say -120 dbw/m^2 in any 4 Kc/s band) over a window approximately 70 degrees wide about the central meridian of the United States compared with that tolerable when the satellite is placed outside this window (i.e., -149 dbw/m^2 in any 4 Kc/s band). The window is significantly narrowed (i.e., approximately 25 degrees wide) when interference in Canada is included. Thus, when the satellites are positioned within this window, the limits on tolerable spectral density may be moderated, and the economics of the distribution system thereby improved without degrading the performance of the terrestrial microwave system.

Interference from the common-carrier microwave transmitters into the down-link receivers at the broadcast stations - type 4d (3) - can be a problem when the station is sited on the main beam of a microwave relay. This problem may be rendered manageable through a combination of careful siting of the broadcast station, placement of the antenna behind a suitable shield (e.g., earth barriers created by excavation) and interference suppression provided by the 15-foot broadcast station antenna.

Much the same considerations apply to type 4d(4) interference from the up-link into the common-carrier microwave receivers. Careful siting

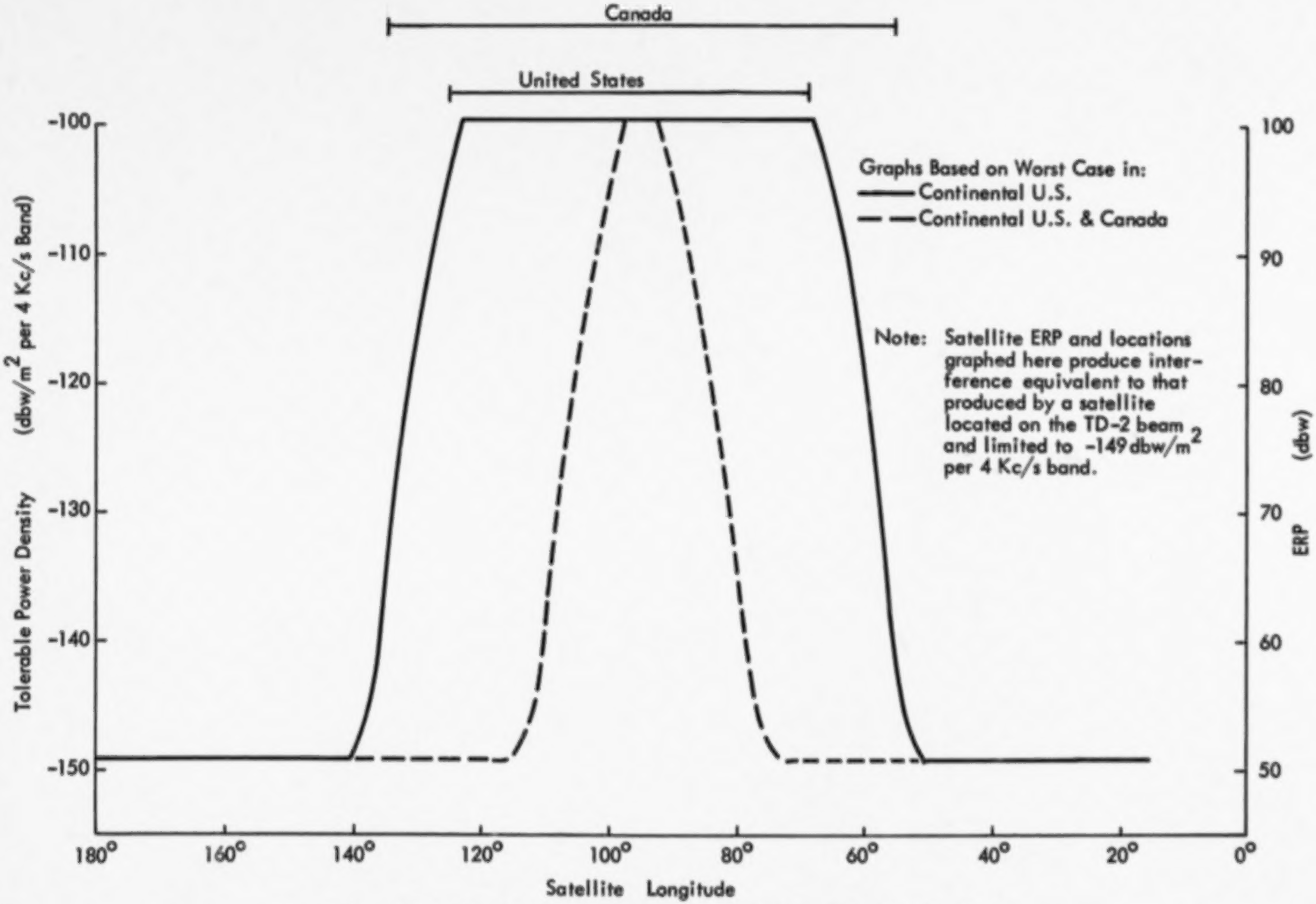


Figure 2. Tolerable Power Density Level and ERP vs. Satellite Longitude

Note: Satellite ERP and locations graphed here produce interference equivalent to that produced by a satellite located on the TD-2 beam and limited to -149 dbw/m^2 per 4 Kc/s band.

and shielding of the fixed sending station, together with the high directivity of its 60-foot antenna, would minimize interference. Although the need may occasionally arise for placing a mobile sending station in close proximity to a microwave relay, the possibility of interference may be minimized by siting the mobile station outside the main beam of the relay and using a remote pick-up.

Although not raised as a question in the FCC Notice of Inquiry, interference may arise in a multiple satellite system because of the fact that, while the satellites are spaced along the synchronous equatorial belt, they all occupy the same frequency band (3700 to 4200 megacycles). The antenna at any receiving installation will normally be directed toward a single satellite, but undesired signals from a number of other satellites will be incident on that antenna. The discrimination between the desired satellite and the adjacent undesired satellite will be provided by a combination of (a) the directivity of the receiver antenna and (b) differences in the polarization of the signals from adjacent satellites. For a 15-foot receiving antenna, a discrimination of 30 db is provided through a 3-degree angular spacing of satellites, and an additional 15 db may be obtained through the difference in the polarization of the signals. While tight angular spacing of the satellite is not essential to the operations of the BNS representative systems, the expected long-term growth in communications traffic will ultimately require a relatively close spacing of the satellites.

4. General Information

The distribution satellite systems here considered employ satellites in synchronous orbit, about 22,300 miles above the equator.

Interference calculations are based on the TD-2 microwave relay systems of the AT&T Company (Roetken 1951) and the newer TH system (Kinzer 1961). The TH system is designed to use the same towers and antenna as the TD-2. These systems account for most of the common-carrier microwave channelmileage in the United States. Selected characteristics of the TD-2 and TH systems are given in Table 2. Microwave relay is rapidly becoming the dominant medium for long-distance telephone traffic. AT&T expects to have 3,000 microwave relay stations installed by 1975 (CCIR 1964).

Distribution of TV programs via satellite is classified under communications-satellite service which shares most of its allocated spectrum with various terrestrial services (ITU 1963). The most important bands involved in such shared allocations at the present time relate to common-carrier microwave relays, as shown in Figure 3. Sharing of common bands requires that each service follow some form of restriction on radiated power.

5. Economics of Distribution Satellite Systems

FCC Regulations limit the range of selection of four important parameters for a domestic satellite system. These are the frequencies of the up-link and down-link and the effective radiated powers from the satellite and Earth station transmitters. It is easily shown that one of these system parameters, the ERP from the satellite transmitter, can have a significant bearing on the economics of a BNS representative system.

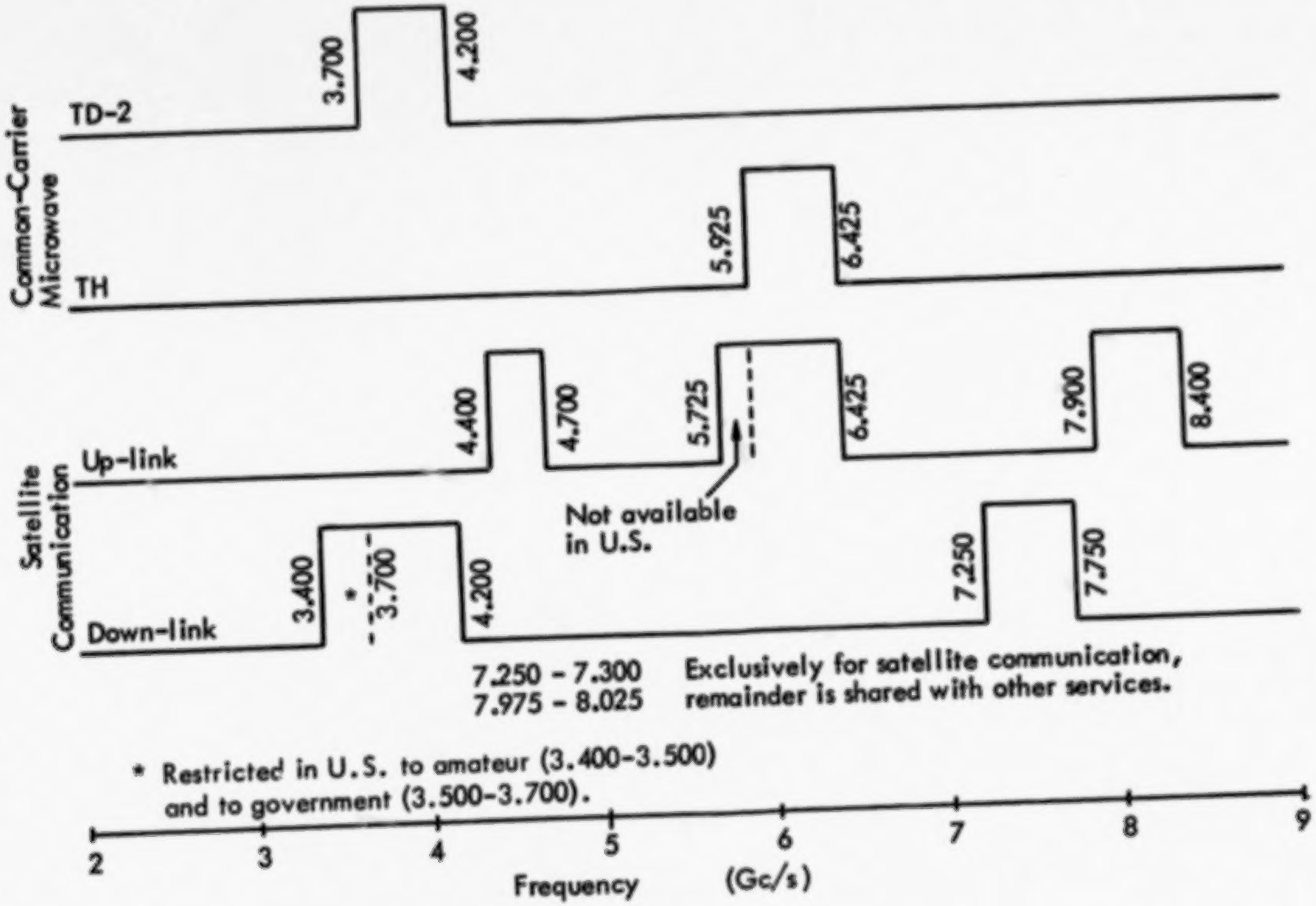
Figure 4 illustrates the limitation imposed by the maximum flux density restrictions on the ERP from a synchronous satellite. The -130 dbw/m^2 total flux restriction limits satellite ERP to 31 dbw, while the spectral density restriction for FM of -149 dbw/m^2 per 4 Kc/s band limits satellite ERP to the range 39-48 dbw, depending upon the bandwidth of the RF signal. The curves for satellite ERP vs. flux in a 4 Kc/s channel are based on the following assumptions:

- The video bandwidth is 4 Mc/s.
- The power density distribution of the satellite signal is uniform over the RF bandwidth (i.e., a flat transmitted spectrum).
- The RF bandwidth is selected in each case to minimize the cost of the Earth station receiver.

Table 2. Characteristics of Microwave Relay Systems

	TD-2	TH
Frequency Band	3700-4200 Mc/s	5925-6425 Mc/s
Multiplexing	Frequency Division	Frequency Division
Modulation	Low-index FM	Low-index FM
Signal Bandwidth	4 Mc/s	10 Mc/s
Transmitter Power (Per Channel)	-3 dbw	7 dbw
Antenna Gain	40 db	43 db
Received Carrier Power	-68 dbw	-57 dbw
Working Channels (max.)	6	6
Channel Capacity (duplex)	1860 TP or 1 TV	1860 TP or 1 TV
Channel Spacing	20 Mc/s	30 Mc/s
Relay Spacing (avg.)	25-30 mi	25-30 mi
Links Installed (1964)	1500	NA
Rate of Installation (1964)	120/yr	NA

NA - Not available



7.250 - 7.300 Exclusively for satellite communication,
7.975 - 8.025 remainder is shared with other services.

* Restricted in U.S. to amateur (3.400-3.500) and to government (3.500-3.700).

Figure 3. Frequency Allocations

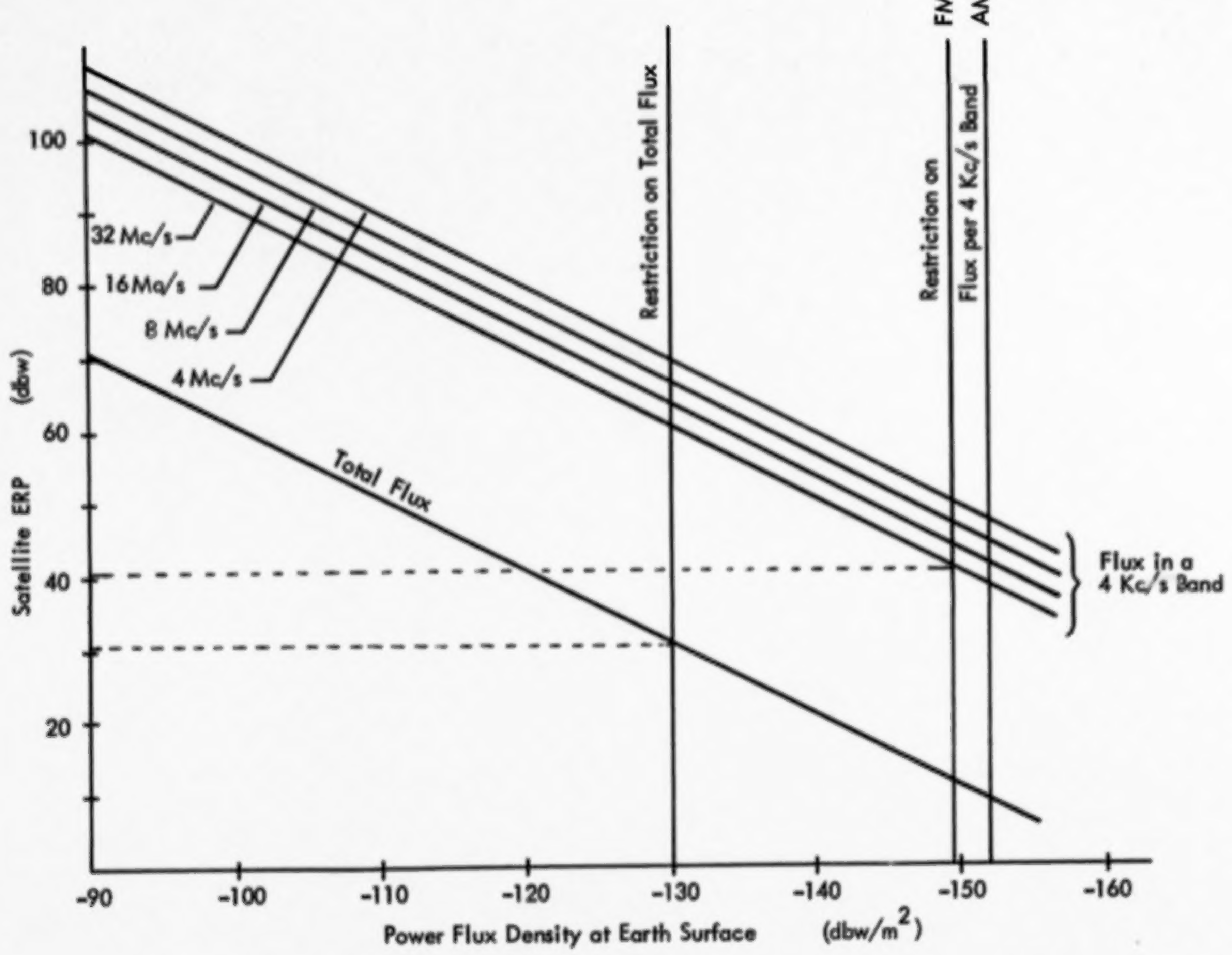


Figure 4. ERP vs. Power Density

The transmitted signal from the satellite follows the laws of free-space propagation.

Figure 5 illustrates the procedure for determining the effect of the present regulations on the incremental cost of a domestic satellite system in the 4 Gc/s band. The cost of the selected components as a function of satellite ERP per channel is given for quantities of 1750 and 5750. The unit cost of the selected components was computed by a method which has been developed to determine the minimum cost receiver configuration for a given satellite taking into account three factors: ERP, frequency, and quantity (Jansky and Sampson 1966). To determine this unit cost, each of the basic components of the receiver was considered separately. Cost information was collected from research and industrial groups involved in the development and design of these components. For the most part, cost of particular components was secured from three or four independent sources, and the variation among sources was found to be small. Determined for the 1970 time period, the incremental cost includes only those components whose selection is dictated by satellite ERP, such as the antenna, feeder line, tuner, and demodulator (in the case of FM).

The satellite cost vs. ERP per channel was determined from data presented in the literature (Ludwig 1966) and from additional information from industrial sources. The satellite cost information relates to systems with 4 and 6 operating satellites, with each satellite distributing 12 TV channels. The three discrete steps of the satellite cost curve in Figure 5 are due to the change in launch vehicle required at particular values of ERP. The total ERP

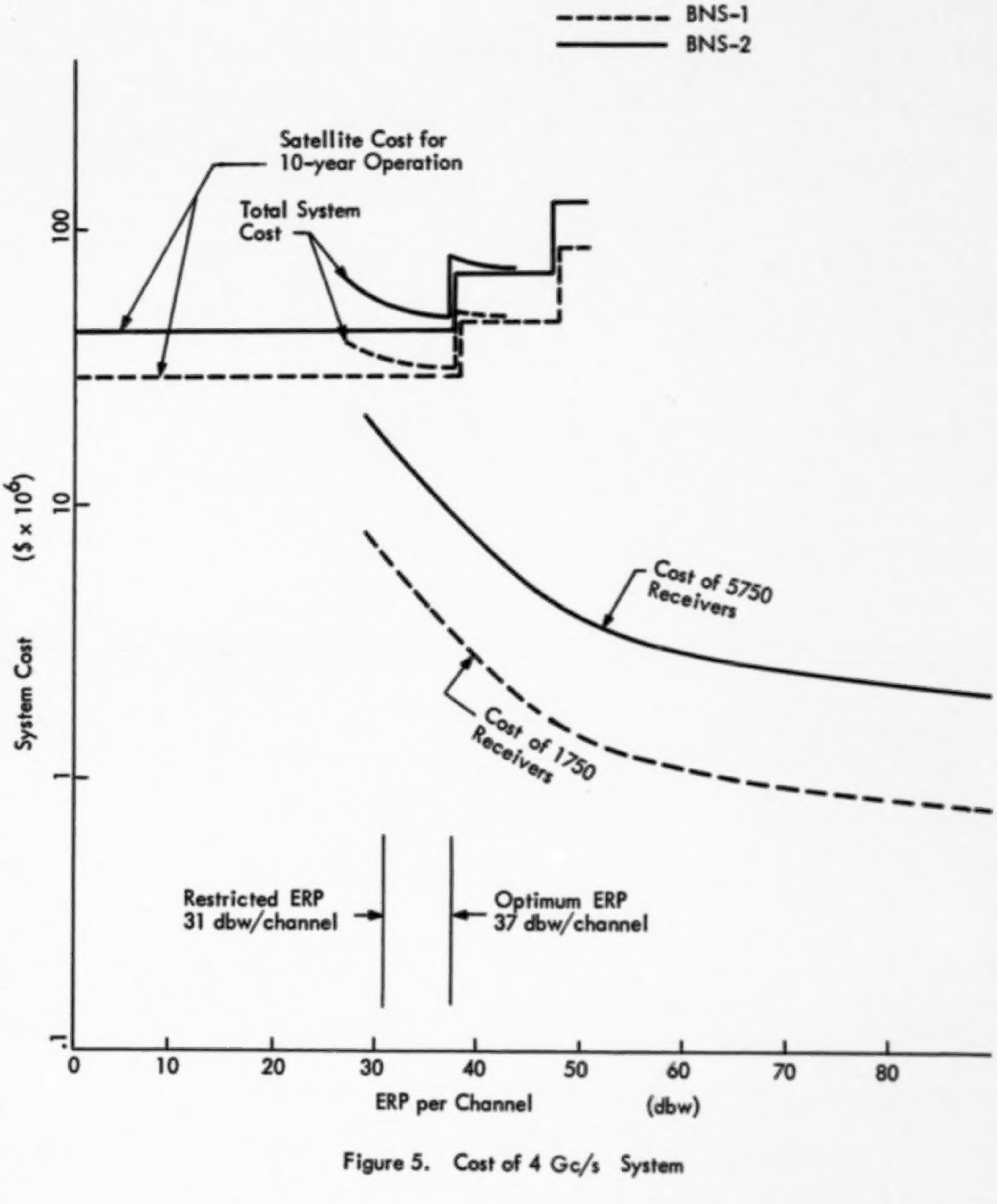


Figure 5. Cost of 4 Gc/s System

and the ERP per channel that can be placed in synchronous orbit by the three types of launch vehicles considered is given in Table 3.

Table 3. Launch Vehicle Capabilities

Launch Vehicle	Total ERP (dbw)	ERP/Channel
Delta	48	37.2
Agena	58	47.2
Titan	61	50.2

The satellite cost data include all costs of the satellite portions of the system for 5 years. These include the costs of 4 satellites emplaced for the BNS-1, and 6 for the BNS-2, plus 2.5 million dollars for station keeping over a 5-year period.

The most economical ERP can then be established. For both the BNS-1 and BNS-2 systems, the most economical ERP is 37.2 dbw/channel. The difference in cost between the most economical system and a system restricted by the -130 dbw/m^2 regulations can now be determined. In determining this cost differential, it is assumed that it is the ERP per channel, and not the total ERP from the satellite, that is restricted to 31 dbw.

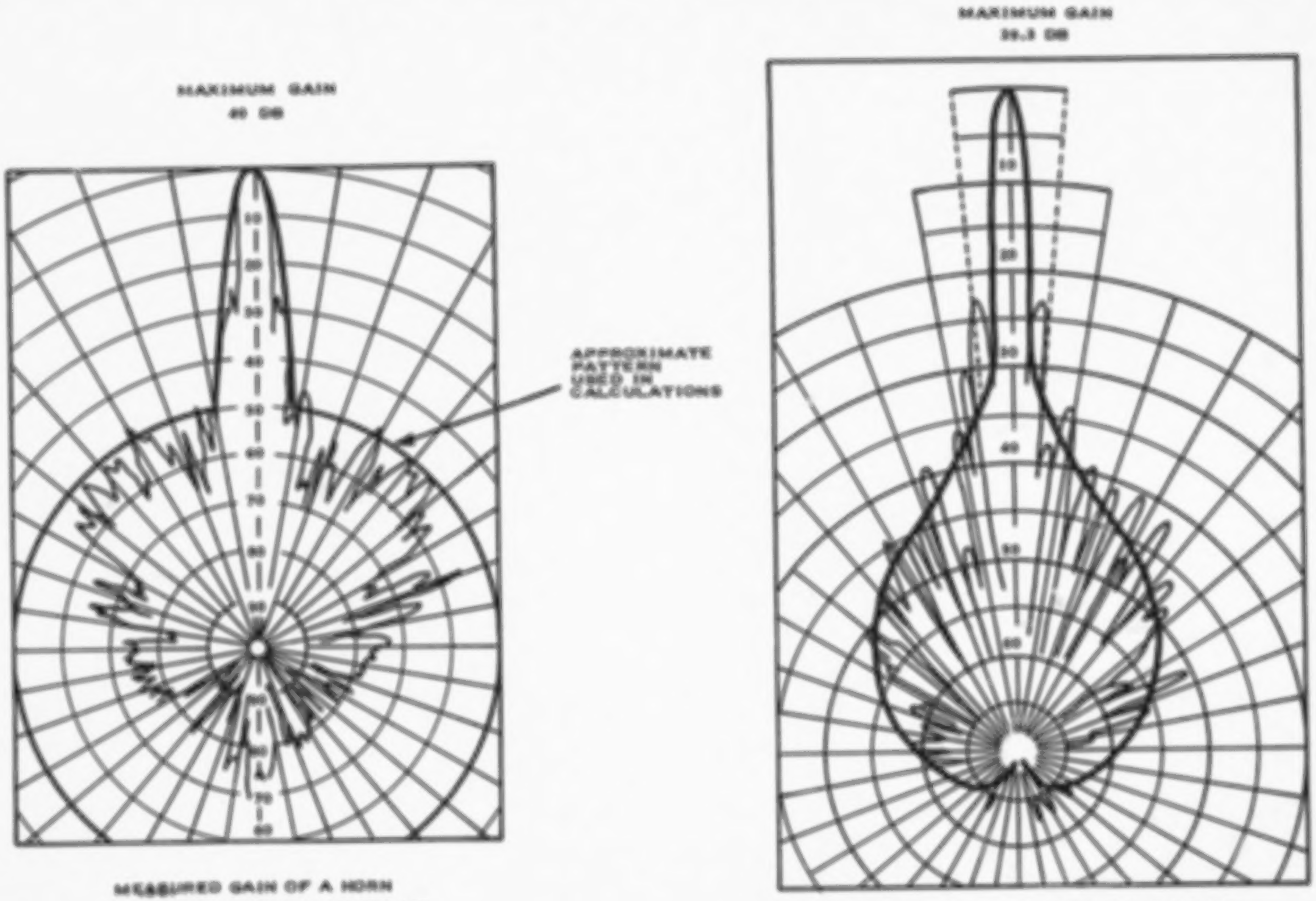
6. Interference between Satellite and Terrestrial Services

6.1 Down-link Interfering with TD-2 Receivers

As shown in the previous section, it is economically desirable to moderate the present restrictions on down-link power from a domestic satellite. The restrictions have been imposed to control the mutual interference between the satellite service and the terrestrial services in the 4-Gc/s and 6-Gc/s bands.

There are several papers (CCIR, USPC IV/122 and IV/192-E) which claim that the restriction to -149 dbw/m^2 per 4 Kc/s band for FM, and the 3-db tighter restriction for AM are justified. These calculations were made for a synchronous satellite positioned on the main beam axis of a common-carrier relay antenna. The interference produced by this situation may approach, but not exceed, the acceptable limits of interference for telephone channels set forth by the CCIR. In data furnished to CCIR Study Group IV (CCIR, 21 August 1964), it has been shown that beam intersection will occur only if the satellite is positioned above the Atlantic or Pacific oceans. For a domestic satellite positioned near the central meridian of the United States, the beam-intersection computations ought to be modified by the gain of the common-carrier antenna in the direction of the satellite. This suppression of interference by the antenna allows a higher tolerable level of power density. Figure 6 gives typical patterns for microwave antennas used in common-carrier systems.

The elevation angle of the satellite signal at any point on Earth can be obtained from Figure 7. For a given position of the satellite, the angle of elevation of the satellite as viewed from each point in the continental United States may be found, and the minimum of these angles of elevation selected. The resulting minimum angle of arrival for each position of the satellite is shown as the curve marked 0° in Figure 8. In the calculations, a maximum latitude of 47° was used for the continental United States. For each position of



APPROXIMATE PATTERN USED IN CALCULATIONS

MEASURED GAIN OF A HORN REFLECTOR ANTENNA AT 3760 MC (CURTIS 1962)

GAIN OF A TYPICAL COMMON-CARRIER MICROWAVE ANTENNA (CCIR USPC IV-128)

GAIN PLOTTED IN DB DOWN FROM MAXIMUM GAIN.

Figure 6. Common-Carrier Antenna Patterns

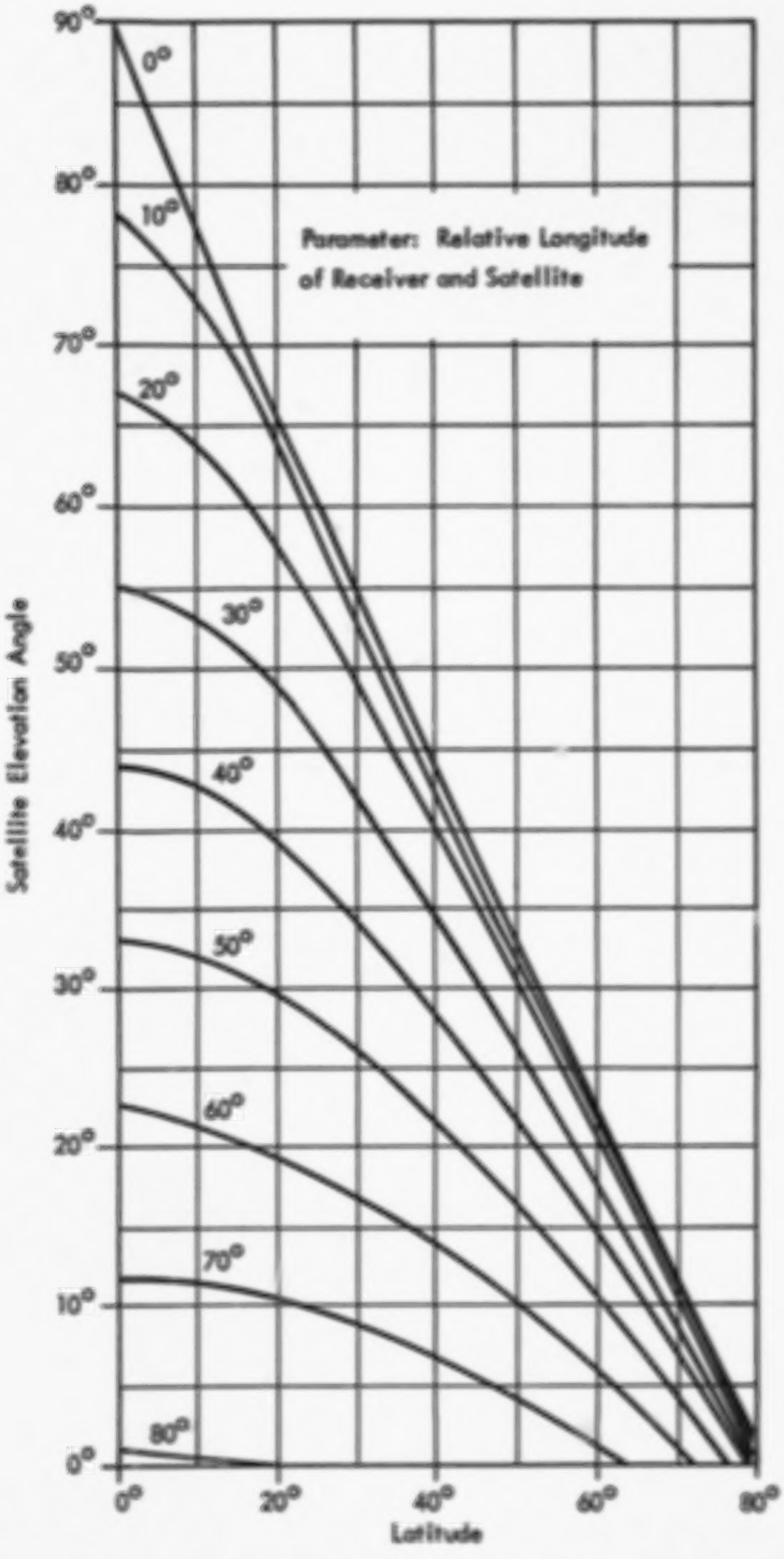


Figure 7. Satellite Elevation vs. Latitude and Relative Longitude

the satellite, the direction of arrival was determined at the microwave relay station in the United States most distant from the satellite. This corresponds to the point of minimum elevation of arrival of the signal from the satellite. The worst case assumed in this study corresponds to a common-carrier antenna elevation of 5 degrees, pointed in azimuth at the sub-satellite point, and located geographically at the worst point in the coverage area. The angle of arrival α of the satellite signal referenced to the main beam of the common-carrier antenna is then found and plotted in Figure 8 as a function of satellite longitude. Using the calculated values of α, the increased antenna interference suppression can be estimated from the horizontal pattern shown in Figure 6. For a horn reflector antenna with square aperture, the vertical pattern will not differ significantly from the horizontal. The suppression provided by the antenna directivity can be translated into an increase of the tolerable level of power density. Figure 9 (included earlier as Figure 2) shows the power density vs. satellite position which would create an equivalent interference with a microwave receiver as would a satellite on the axis of the microwave antenna beam operating at the present power limit.

A satellite may create interference through the antenna side lobes of each of a series of stations in a microwave network. In analyzing this problem, we assume the reference relay network of 50 stations suggested by CCIR, and an interference of the same low order of magnitude occurring in each station. Under these conditions, the tolerable flux level would be reduced by a factor of 50, i.e., 17 db. Even when the values plotted in Figure 9 are reduced by 17 db, there still remains

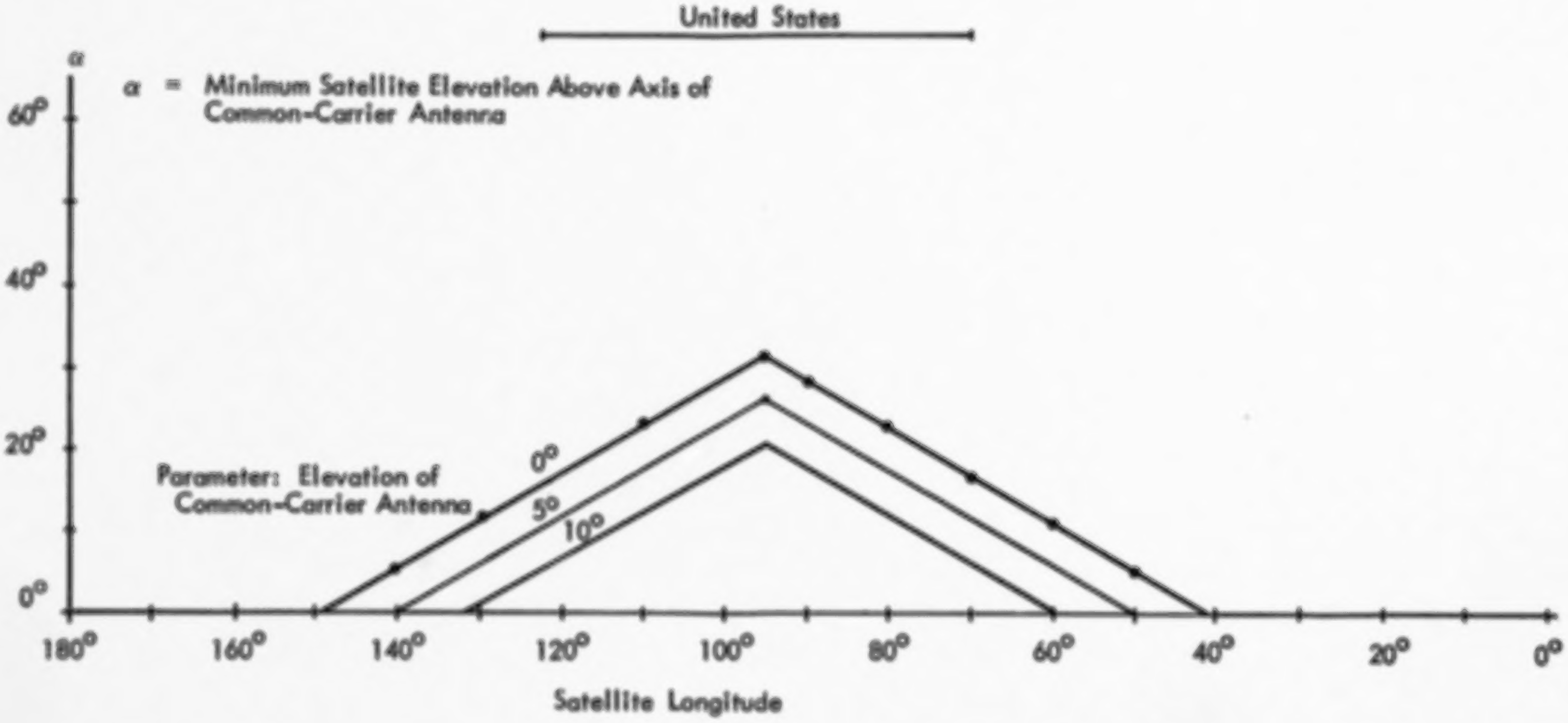


Figure 8. Satellite Elevation Above Axis of Common-Carrier Antenna vs. Satellite Longitude

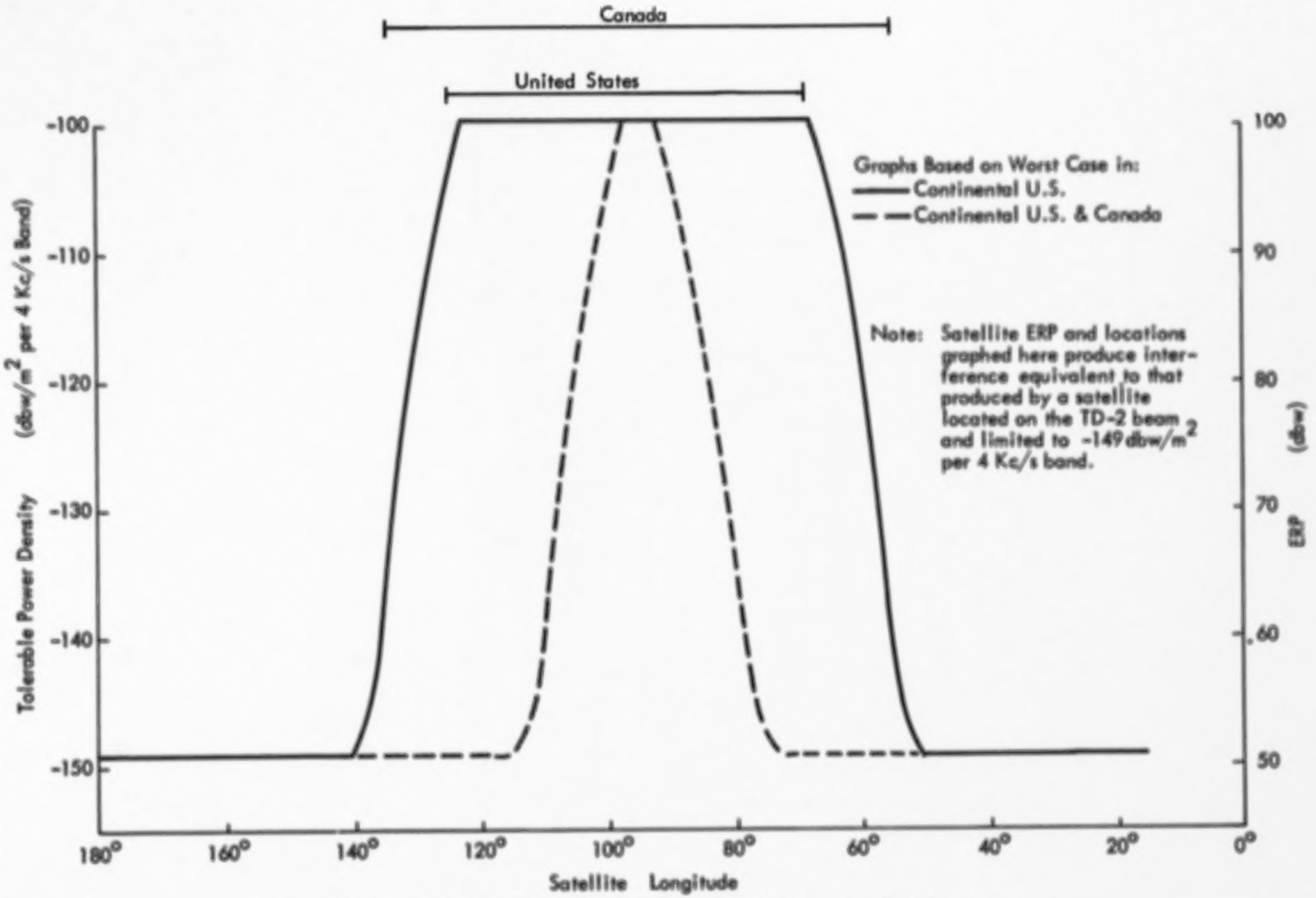


Figure 9. Tolerable Power Density Level and ERP vs. Satellite Longitude

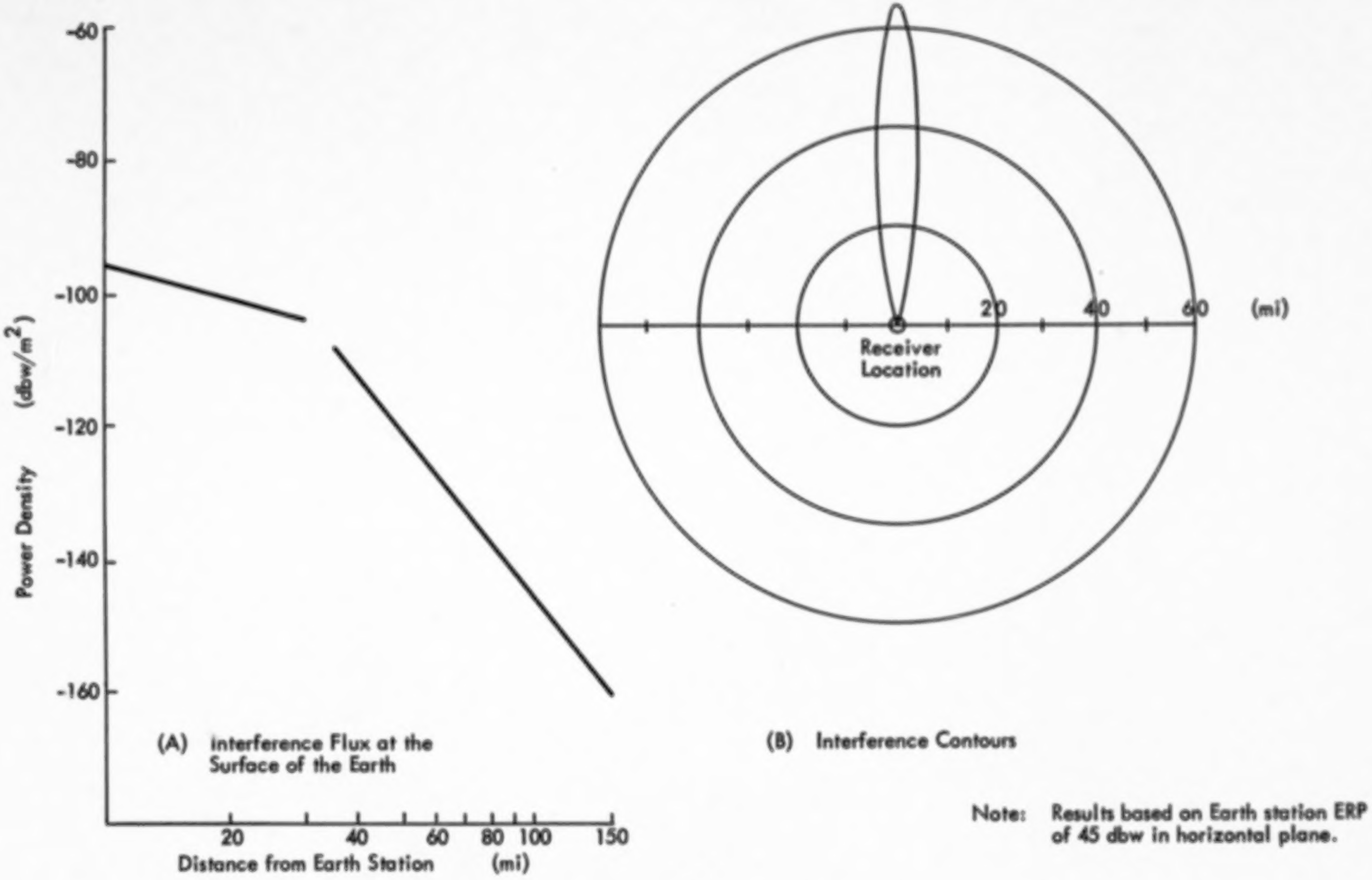
ample margin for increase in ERP without interference with the common-carrier microwave systems. Thus, the limit of -149 dbw/m^2 per 4 Kc/s band may be increased considerably when the distribution satellite is emplaced in the window.

6.2 Up-Link Interfering with TH Receiver

The present FCC regulation regarding the up-link transmitter power states that a maximum of 45 dbw can be radiated in the horizontal plane. It is technically feasible to obtain at least 40 db more gain in the direction of a satellite than in the horizontal direction. This permits up-link power of as much as 85 dbw, which is greater than required. Assuming 45 dbw radiated in the horizontal plane and typical 6 Gc/s propagation data (Curtis 1962), the separation from the up-link transmitter and a local common-carrier receiver must be 65 miles in the direction of maximum radiation. Power density vs. distance from the transmitter is shown in Figure 10, along with minimum separation contours. The 65-mile separation applies only to a small azimuthal sector, as can be seen from Figure 10. Thus, there is ample freedom in locating fixed sites for program-originating stations. If there is ever a need to originate a TV program from within the narrow interference contour of a TH receiver, this can be done easily by using a remote pick-up at the program source to transmit to the mobile up-link transmitter located off the axis of the TH antenna.

6.3 TD-2 Transmitter Interfering with Earth Receiver

A similar analysis made of the effect of a common-carrier transmitter on an Earth station receiver in the satellite service would likewise



(A) interference Flux at the Surface of the Earth

(B) Interference Contours

Note: Results based on Earth station ERP of 45 dbw in horizontal plane.

Figure 10. Earth Station Transmitter Interfering with TH Receiver

show that interference may be a problem in a small azimuthal sector. In the few cases where it may be necessary to locate an Earth station receiver in this narrow interference region, the antenna can be shielded to reduce the interference to tolerable levels.

7. Interference from Adjacent Satellites

For satisfactory TV reception, the desired signal strength should be at least 40 db above the sum of the interfering co-channel signals, and 25 db above the sum of the interfering adjacent channel signals. For a 12-channel system, the total adjacent channel signal strength, at the receiver input, will be only 10.8 db above the co-channel interference. If the co-channel interference is adequately controlled, the adjacent-channel interference will be also.

The 40-db co-channel interference margin can be used to establish the minimum satellite spacing in longitude in the synchronous equatorial belt. It will be assumed that the satellites in a multiple satellite system will be equally spaced within the window, and that each satellite will distribute 12 channels to all parts of the United States. Polarization discrimination can easily provide 15 db suppression. The polarization could alternate between time zones. In order to satisfy the 45 db margin,30 db of suppression must be obtained by the receiving antenna.

Using a 15 foot parabolic antenna, one can obtain a 43-db maximum gain and a half-power beam width of 1.3 degrees. Due to the variation of the satellite positions and the limitations in accuracy in pointing the receiving antenna, it may not be feasible to position the interfering satellite at a null point in the antenna pattern. Conservative design practice suggests that antenna discrimination be evaluated in terms of the overall envelope. For a 15-foot antenna with accurate control of the aperture distribution, 30 db of suppression can be obtained 3 degrees off the main beam. Closer spacing of satellites could be obtained if larger receiving antennae were used.

8. Assumptions

Orbit is synchronous and equatorial.

Station-keeping controls and orbit inclination are such that satellite position is within 0.1 degrees of a fixed geodetic position.

The estimates of receiver cost vs. quantity are based on a learning curve.

The satellite antenna which is assumed in the satellite costs vs. ERP curves is the largest rigid antenna which can be accommodated by the satellite shroud.

Satellite ERP affects the cost of the satellite itself, as well as the receiving antenna, tuner, feeder and demodulator.

The maximum interference rejection of a common-carrier microwave antenna is 50 db. A typical microwave receiving antenna has a gain of approximately 40 db at beam center and a gain of -10 db at angles greater than 10 degrees from beam center.

The satellite-service Earth transmitter and receiver have antennas which are omnidirectional in the horizontal plane.

A satellite located on the main beam of a microwave receiving antenna will not cause excessive interference at that station if its spectral density is limited to -149 $\mathrm{dbw/m^2}$ in any 4 Kc/s band.

No common-carrier microwave antenna is elevated more than 5 degrees above the local horizontal plane.

9. Glossary

α	Difference between the angle of arrival of the satellite signal and the elevation angle of the common-carrier antenna
CCIR	Comité Consultatif International Radio
db	Decibel, a logarithmic unit of power ratio
dbw	A power level expressed in db above one watt
ERP	Effective radiated power
ETV	Educational Television
Gc/s	Gigacycle/second = 10^9 cycle/second
ITU	International Telecommunication Union
Kc/s	Kilocycle/second = 10^3 cycle/second
Mc/s	Megacycle/second = 10^6 cycle/second
TD-2	Common-carrier microwave system operating in 3700-4200 Mc/s frequency band
TH	Common-carrier microwave system operating in 5925-6425 Mc/s frequency band

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Respectfully submitted,

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